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# The Role of School and Motivational Factors in Mathematics Achievement and Self-Efficacy : A Multi-Level Analysis

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## CHAPTER ONE

### INTRODUCTION

#### 1.1 Introduction

The performance of U.S. students in national and international mathematics assessments has been unsatisfactory (Hanushek, Peterson & Woessmann, 2010). The Program for International Student Assessment (PISA), a system of international assessments that focuses on 15-year-olds' capabilities in reading, mathematics and science, placed U.S. students below most of those in the other developed nations in the Organization for Economic Cooperation and Development (OECD), that participated in the 2009 assessment. The country's performance in mathematics was described as below average and placed 25<sup>th</sup> out of the 34 participants (Fleischman, Hopstock, Peczar & Shelly, 2010).

Only 31% of the U.S. students performed at or above proficiency. Shanghai, a province in China, was the highest ranked entity with 75% at or above proficiency. According to Strutchens & Silver (2000) and Flores (2007), the U.S. national average cannot be compared to other participants like Shanghai because of differences in the size of the economies and diversity in culture, languages, curriculum, and state standards. However, the National Center for Educational Statistics (NCES) compared the small economies with similar units in the U.S. like the best performing states, Massachusetts and Minnesota. Only 51% and 43% of their students respectively performed at or above proficiency (NCES, 2010). The performance of the top states

is still distinctly lower than Shanghai. The 2009 students' average score was higher than 2006 by two percentage points but not significantly different from 2003.

Comparable assessments confirm the trends. For example, the 2007 Trends in International Mathematics and Science Studies (TIMSS) showed that only 10% of fourth graders and 6% of eighth graders performed at or above the advanced international benchmark. Although the 4<sup>th</sup> and 8<sup>th</sup> grade performances improved by 11 and 16 points respectively between 1995 and 2007 (TIMSS, 2007), there was no measurable difference in the percentages of those scoring at advanced benchmark. Nationally, the National Education Assessment Program (NAEP), in the Nation's report card in mathematics for 2011, results showed that both 4<sup>th</sup> and 8<sup>th</sup> grade students improved their performance by a point compared to 2007, but the percentage of those performing at advanced did not change (NAEP, 2011).

The low achievement and the persisting trends in mathematics performance have negative implications at various levels. For example, Peterson, Woessman, Hanushek & Lastra-Anadón (2011) stated that the mathematics underachievement can adversely impact the national economy in the long run. The study stated the following:

Assuming past economic patterns continue, the country could enjoy a remarkable increment in its annual GDP growth per capita by enhancing the math proficiency of U.S. students. Increasing the percentage of proficient students to the levels attained in Canada and Korea would increase the annual U.S. economic growth rate by 0.9 percentage points and 1.3 percentage points, respectively. Since long-term average annual growth rates hover between 2 and 3 percentage points, that increment would lift growth rates by between 30 and 50 percent (p10).

The significant national economic implication attributable to mathematics underachievement cannot be ignored. Furthermore, the negative implications on underachieving individuals which include unequal access to higher education and employment opportunities—are life impacting.

### 1.2 Statement of the problem

National and state education agencies are concerned about mathematics underachievement and are searching for solutions. For example, when reacting to the 2006 PISA results, former U.S. Education Secretary Margaret Spellings said that the department of education has long been advocating for more rigor in the nation's high schools, adding resources for advanced courses to prepare students for college-level studies, and encouraging stronger mathematics and science education (Johnson, 2010). These actions, aimed at setting the stage for better performance, have not fully addressed the mathematics underachievement problem. There is need to supplement the effort by looking at the underachievement problem from other perspectives. Underachievement in mathematics has both long and short term, individual and collective negative implications.

Despite the many recommendations and implementation of programs to improve mathematics performance, both the international and national assessments indicate dismal progress. Solutions to mathematics underachievement continue to be elusive. Therefore, more studies are needed to address the mathematics underachievement problem. The studies need to address the problem from multiple perspectives. Motivation and self-efficacy in learning are invaluable, but their roles in, and relationship to mathematics achievement have not been fully appreciated. Motivation is multifaceted too: it has components generally accepted as defined, and others that are subjectively definable. This study defines motivational scales and self-efficacy in

the context of the ELS -2002 survey (see Appendix A), which is different from the self-efficacy scales as used in Bagakas (2011), Johnson (2008) and Pajares (1996, 2002) and related those scales to mathematics achievement.

The hypothesis is that learners' motivation and other psychological and somatic states about school and academic work are related to how much they learn and demonstrate in achievement. In his social cognitive theory, Bandura argues that both the motivation and achievement (behavioral factors) are related to learners' socio-demographic characteristics (personal factors), and school context (environmental factors) (Bandura, 1989). The problem is that not much is known about how factors interact and how they could be used in intervention, especially to improve mathematics achievement. According to Darling-Hammond (2010), although programs that emphasize rigor, physical resource provisions, teacher quality, and technology are unequally distributed among the higher and lower socioeconomic status, racial groups and regionally, the role of personal and psychological factors in underachievement cannot be ignored.

The overall problem is that mathematics underperformance is both an individual and collective problem. The psychological variables have not been exhaustively related to mathematics achievement. Furthermore, they have not been studied abundantly in different school contexts. This study, therefore, identifies unique student motivational variables, studies them as nested in school contexts, using a multilevel approach, and seeks relationships that could be relevant in improving mathematics achievement.

### 1.3 Purpose

Motivation and engagement are interrelated and key in learning mathematics (Peterson & Fennema, 1985), and self-competence, self-efficacy, and self-esteem, are significantly related to

engagement in learning activities (Akey, 2006). However both the definition of motivation and self-efficacy, and their dimensions are widely varied. Teacher practices, individual and collective efficacy, and students self-efficacy and performance were found to be linked in different ways (Bagakas, 2011; England 2006; Johnson, 2008; Pajares, 2002).

According to Bandura (1999), self-efficacy, achievement, engagement and motivation have a triadic reciprocal causation relationship. The main purpose of this study is to relate these components in seeking the explanations and solutions to the mathematics underachievement problem through multiple methods. First, explore the triadic reciprocal relationships between motivational factors, mathematics achievement and mathematics efficacy. The aim is to ascertain the relationships and how they influence mathematics achievement. The information gained can be used by administrators, teachers, psychologist and counselors in programming intervention for better performance in mathematics.

Second, study the relationships between mathematics achievement, motivational factors and, student socio-demographic characteristics such as gender and race, in a hierarchical form within school contexts. The contexts include location, socioeconomic status, sponsorship and academic climate. The multi-level relationships identified can give stakeholder deeper insight into the origins and causes of mathematics underachievement, and how to uniquely address them according to learner characteristics and contexts.

Third, explore the learning theories, specifically Bandura's reciprocal determinism theory, empirically test it, and create knowledge for intervention to improve mathematics performance. Fourth, study mathematics achievement using different variables and combinations to supplement other studies. The study utilizes two-level hierarchical linear models with student measures at level one and school measures at level two.

Fifth, identify relationships between new motivational variables and mathematics achievement, and recommend effective variables for inclusion in intervention programs. Brunner (2008) argues that, research in the behavioral sciences in general, and educational research in particular, aims to advance the understanding of the relationships between theoretical constructs. Research helps identify the conditions that mediate relationships among the constructs. Multi-level data, such as used in this study, provide an opportunity to explore both direct and indirect relationships, over time and across groups.

Sixth, explore the large database for new variables and relationships. This study utilizes the Educational Longitudinal Survey of 2002 (ELS-2002) database, because it has multilevel variables, is longitudinal, and other interesting contemporary studies have been based on it.

#### 1.4 Research Questions

The study addressed the following research questions:

1. To what extent do students' motivational attributes— such as extrinsic motivation, effort and persistence, individual determination and learner preparedness, and personal characteristics such as gender and race— predict their mathematics self-efficacy and achievement?
2. To what extent do school sponsor, location, socioeconomic status and school climate predict a school's adjusted average in mathematics self-efficacy and achievement?
3. To what extent do school sponsor, location, socioeconomic status and school climate mediate the relationships between mathematics self-efficacy and mathematics achievement, and motivational attributes such as extrinsic motivation, effort and persistence, individual determination, and learner preparedness?

4. To what extent do schools' sponsor, location, socioeconomic status and climate mediate the gender and race gap in mathematics self-efficacy and achievement?

#### 1.5 Significance of the study

The subjects of the study are high school students. High school years mostly coincide with adolescence (11-19 years). Sinha, Cnaan & Gelles, (2007) analyzed a national sample of youths and concluded that, adolescence is characterized by risk taking behaviors, solidifying identity and making lifelong impacting decisions. The stage also presents an opportunity to embrace positive societal values. This study informs decisions by different school staffs and parents, for and about students, mostly adolescents, in their everyday interaction. Such decisions significantly determine and influence their behavior, choices and outcomes. The study findings may be beneficial in advising, counseling, intervening and modeling for students. This study of high school students is significant in two ways: 1) it makes management and instruction of adolescents more valuable and relevant, and 2) it relates school achievement to personal psychological factors and school contexts.

Watt (2004) observed that expectancy-value social cognitive constructs are very important in understanding and influencing the development of achievement related outcomes over time. This study considered other social cognitive constructs and related them to mathematics achievement and self-efficacy. The understanding thereof can be used for planning instruction and intervention. This is significant because mathematics underachievement is a problem with far reaching implications measurable at both individual and collective economic levels (Hoyles, Wolf, Molyneux-Hodgso, & Kent, 2002; Peterson, Woessman, Hanushek & Lastra-Anadón, 2011).



Jacobs, Lanza, Osgood, Eccles, & Wigfield (2002) observed that mathematics ability self-perceptions decline linearly, from grade 1 through 12, but also increase in accuracy over the same period. Michelson (1990) also differentiated abstract from concrete attitudes, and observed that concrete attitudes are formed at high school and are related to behavior and academic achievement. Specifically student behavior and attitudes towards curriculum, teachers and school generally have significant relationships with achievement. Motivational attributes like attitudes, self-efficacy and perceived competence are psychological factors related to engagement and learning, This means that self-efficacy and other motivational constructs at high school, have concretized and can be accurately measured, and if related to achievement outcomes may lead to stable conclusions. This is significant for generalizable study results.

Institutional administrators and policy makers will benefit from the findings as they will tailor curriculum at high school level to match intended goals. Knowing the relationships between environments, personal and behavioral performances, and mathematics achievement is important for planning and programing intervention.

### 1.6 Theoretical framework

The theoretical basis of the study is Bandura's triadic reciprocal determinism model. The basic principle of the theory is that academic performance is dependent on what the students learn and learning both as a process and product is dependent on reciprocal relationships between environmental, personal and behavioral factors (Bandura, 1989). Bandura also identified three factors that determine the learning outcomes: individual choices and actions (behavioral factors), physical and social surroundings (environmental factors), and cognitive, physiological and psychological (personal factors) (Bandura, 1986).

In another related study Bandura stated the following:

In this model of reciprocal causality, internal personal factors in the form of cognitive, affective and biological events; behavioral patterns, and environmental events all operate as interacting determinants that influence one another bi-directionally.....In triadic causation there is no fixed pattern for reciprocal interaction. Rather, the relative contribution of each of the constituent classes of influences depends on the activities, situational circumstances, and socio-structural constraints and opportunities (Bandura, 1999, p.6)

The students' behavioral and personal factors (such as race, gender, intelligence, motivation, and self-efficacy), interact with school environmental factors such as sponsor, location, socioeconomic status and climate, bi-directionally, to cause measurable changes in all the three components in the triadic model.

The original triadic framework stated that human function is as a result of the interaction of the three distinct factors: behavioral, personal and environmental. Behavioral factors are what other people perceive of others mainly through the five common senses (hearing, touching, tasting, seeing and smelling). The factors include actions, verbal and non-verbal expressions. According to social cognitive theory, an object or action can elicit different behavior from different people. Hence we see people, animals, cars, colors, and academic subjects liked and disliked by others. According to Pajares (2002) this response to the external and internal environment is "behavior." Mathematics achievement, effort and persistence, and learner preparedness are considered behavioral factors in this study.

Environmental factors include the physical (weather, mountains, arrangements), social (people, relationships), and cultural (language, values and roles). According to Bandura (1999), environment is not monolithic; it can be viewed as imposed, selected or constructed for the

youth. Environmental factors can be perceived as imposed as youth do not have control over them. Schools present different environments in different measures. Students individually or collectively, behave differently according to their perception of the environment. Their actions also determine the environment around them. School climate, socioeconomic status, sponsor and location are considered environmental factors in this study. Reciprocal determinism theory could hold that environment interacts with behavior to cause change in both the actor and the environment.

Personal factors can be classified into psychological, physiological and cognitive. They include thoughts, preferences, temperament or personality, and intelligence. Although race and gender are arguably social and personal factors, in this study they are considered personal. In this framework, personal, environmental and behavioral factors interact bi-directionally to cause change in each other.

Bandura (1989) reiterated that, human behavior changes have been conceptualized as either being mechanical, autonomous or emergent interactive. Mechanical change of behavior occurs when people respond to the environment and change accordingly without motivation, self-reflection, creativity, or self-directive properties. In a school, it is likened to when students take instructions handed down by authority, without question or input. Behaviorist John Watson's claim that all behavior is observable, that people have no free will and that behavior is a result of stimulus-response relationship, could be a good example of mechanical behavior change. This means that behavior is purely in response to some experience. Watson's claims have been criticized and most of them repudiated.

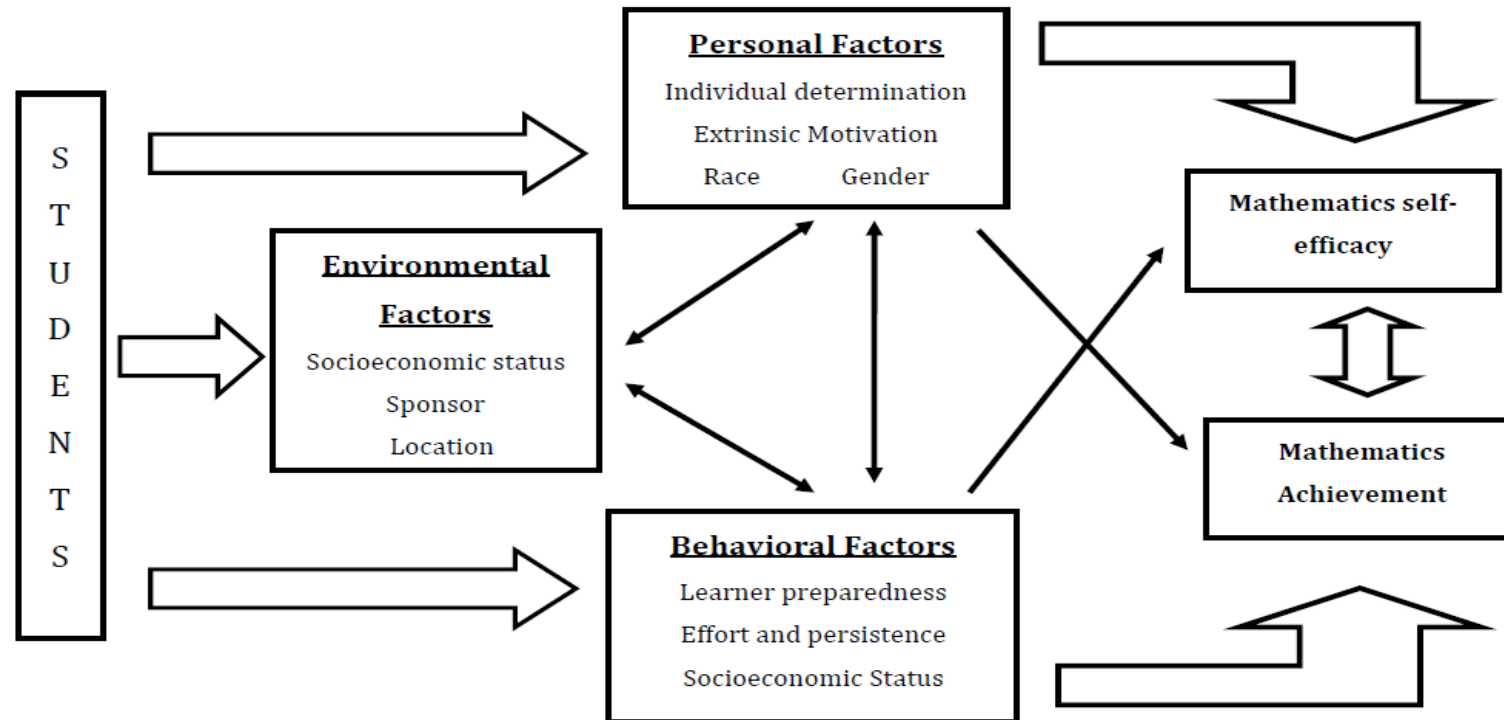
Autonomous behavior change occurs when humans serve as entirely independent agents of their own actions. Pure autonomous situations include students' choices independent of

everybody, to learn or not, what to learn, when and how. Teachers also respond to students' behavior in varied ways. This theory of behavior change, on its own has little following without any modification (Bandura, 1989). Mechanical or autonomous behavior changes are both considered one-directional and unrealistic in the human nature.

The social cognitive theory from which triadic reciprocal determinism originates adopts the emergent interactive model of behavior change. Emergent interactive behavior change holds that people are neither just autonomous nor mechanical, but rather have a reciprocal causation where personal, behavioral and environmental factors interact to cause change in the person and in the environment. This means that factors like intelligence, affect, forethought, self-reflection, self-regulation and motivation can lead to certain outcomes dependent on environmental contexts, personal factors, and the behavior of self and others.

In this study, school climate, school sponsor, socioeconomic status and location are considered environmental factors that will interact with the students' personal factors (mathematics self-efficacy, individual determination, extrinsic motivation, gender and race) and behavioral factors (learner preparedness, effort and persistence) in influencing self-efficacy and mathematics achievement. The hypothesis is that students' behavioral and motivational factors and environmental contexts have a triadic reciprocal interaction that influences mathematics outcomes. Figure 1.1 is a visual representation of a modified reciprocal determinism model.

Figure 1.1 Modified reciprocal determinism model



## CHAPTER TWO

### REVIEW OF LITERATURE

#### 2.1 Introduction

In chapter one, this study introduced mathematics underachievement as a problem that deserves attention. Despite the many studies on the problem, along with recommendations and implementations of proposed solutions and programs, the problem persists. Yet, as the former U.S. Education Secretary, Margret Spelling, aptly observed, this kind of performance of America's students is a problem that the economy can neither afford to accept, nor ignore (Johnson, 2010).

This chapter delves deeper into the current literature on the mathematics underachievement. It begins with a discussion on the reasons for great interest in mathematics achievement, follows with a discussion on role of socioeconomic status, and mathematics self-efficacy and its relationship to mathematics achievement. A look at motivational factors and their influence on both mathematics self-efficacy and mathematics achievement concludes the chapter.

#### 2.2 The value of mathematics skills

The value of mathematics in modern society cannot be overemphasized. Mathematics underachievement in state, national and international assessments denies the students the benefits

attached to the value of mathematics, which include job prospects and academic advancement, and the nation, the general economic value of an educated citizenry. In the U.S., as in many other developed countries, it is of great concern to political and institutional administrators that being outperformed in mathematics, a core subject in and with, technology, engineering and science, will lead to competitive disadvantage, a step towards being economically outdone by other developed nations.

Steel (2012) observed that Science, Technology, Engineering and Mathematics (STEM) subjects are continuously emphasized in education systems throughout the world, and any technological development is dependent on how future generations understand the subjects. Mathematics is of particularly great interest and concern because of its important role in educational advancement, its strategic role as partner and tool in the other subjects, and its demand and rigor as a stand-alone discipline. Darkwing (2012) observed that the subject is a human endeavor (because of its use in everyday life), it's a discipline like history, philosophy, archeology or economics, and it's an interdisciplinary language and tool because of being an important component in learning and doing in other disciplines.

According to Bagakas (2011), high achievement in mathematics is important for joining a variety of colleges and specific majors. It is also a foundation for technological and scientific development. Mathematics serves as a representative measure of general academic achievement, intelligence and competence (Brunner, 2008). It is a science because its theory can be empirically verified, and scientifically replicated, and an art because of its symbols, aesthetic patterns, logical reasoning, and abstraction. It cuts across many subjects both as a tool and/or partner. Mathematics also stands on its own with unique reasoning, language, theory and practice.

Mathematics is a critical filter that determines subsequent educational achievement and post-secondary education attainment, and students who perform poorly in mathematics are discouraged or restricted from enrolment in advanced mathematics courses, which are normally prerequisites for higher status courses in college (Gemici & Rojewski, 2010). Newton, Torres & Rivero (2008) observed that underperformance in mathematics at K-12 level wastes students' resources (time and money) at college level. Underperforming students are required to take pre-college courses in mathematics and related subjects at college, at a college cost. Because of the cost inherent in inadequate preparation, STEM related programs suffer low enrolment.

Mathematics literacy is a major requirement in most workplaces. Hoyles, Wolf, Molyneux-Hodgson & Kent (2002) said that employers prefer mathematics skills for one or more of the following five interrelated purposes: improving efficiency, dealing with constant change and innovation, informing improvement, remaining competitive, and maintaining operations. Accordingly, while different employers require different levels of mathematics skills, all employers require mathematics literacy. High school mathematics is especially important, as it provides learners with basic skills for employment and introduces advanced skills for higher education.

Peterson (2011) observed that twenty two percent of American businesses could not find people with good mathematics technical and analytical skills to hire, while the Bureau of Labor Statistics projected that thirty of the fastest growing professions will require employees with a minimum of college degree, preferably in the STEM fields. There is need for enhancing mathematics achievement to satisfy employer needs, for higher education and in readiness for jobs in the fastest growing professions.



The Bureau of Census 1999, referred the following to as ‘familial and personal factors’ in classifying students as educationally at-risk: the presence of a disability, speaking English less than “very well,” low family income, absence of one or both parents from the household, at least one or both parents being of recent immigration status, the presence of an unemployed parent in the household and poor performance in mathematics (Kominski, Jamieson, & Martinez 2001). The inclusion of mathematics in the list ascribes a social role to the subject, besides the academic and economic roles.

In a study on early mathematics achievement as a critical filter in career aspirations trajectories of adolescents and young adults, Shapka, Domene & Keating (2006) observed that mathematics performance at high school is a major determinant of career aspirations. The study observed that students who performed poorly at 9<sup>th</sup> grade aspired to less than first ranked courses in all fields (health, technology, business, physical and social sciences). First ranked courses are those viewed as prestigious, demanding and rigorous, generally described as difficulty to get into and “hard” to complete. They are the high income earners.

Phillips, Burns, Wagner, Kramer & Robbins (2002) observed that the adolescents who are likely to move from high school through postsecondary education and work are those with generalizable work skills, clear and realistic plans, optimistic about their plans, resilient in facing obstacles, and generally not failing in mathematics.

Thus studies on the curriculum, standards, outcomes, pedagogy of mathematics, and its relationship to and role in the STEM fields— and indeed all other subjects— are of great importance to teachers, parents, educational administrators, other stakeholders and the economy in general. In addition, the personal, behavioral and environmental factors that influence mathematics learning and performance are fields of interest to educators, psychologists and

philosophers not only to further understanding and solving human problems, but also as areas of interest in the specific theories and practices of the specializations.

### 2.3 Some documented reasons for underachievement in mathematics

Performance in mathematics is gauged on the correctness or error in objective mathematical reasoning when working a mathematical problem which leads to incorrect/correct solution. Incorrect solutions to mathematical problems are due to either the inability to recognize which skills are required for solving a particular problem or the lack of the skills themselves. These are indicators of low fluency in mathematical concepts (Tuminaro, 2004).

Fluency in mathematical skills and concepts refers to the ability to correctly work out mathematical problems precisely, accurately and in a timely manner. Fluency is essential for standardized tests because they are normally timed, are out of the sequence that they were taught, and require deeper understanding, application and variety of methods. Fluency is a cause of variability in the choice of method, thus variability in achievement (Goodwin, Ostrom & Scott, 2009).

Mathematical fluency, especially in higher grades, is a combination of several factors including cultural capital, the level of parents' education, and language. Alon, Domina, & Tienda, (2010) attributed the college degree attainment gap between the Hispanic and the White students to lower parental education levels among Hispanic families. Although this conclusion was drawn based on the general education trends, the situation is worse in more demanding subjects like mathematics. Students with educated parents start school with and benefit from their parents knowledge, network and resources that support their learning in school. This is referred to as the cultural and social capital.

A study done by Mji & Makgato (2006) in South African attributed poor performance in mathematics to educator preparation. The study found most teachers to be less knowledgeable in content and pedagogy. The study broadly categorized the teacher factors into problems in (a) teaching strategies; (b) insufficient content knowledge and understanding; (c) low motivation and interest; (d) limited and inappropriate use of laboratory; and (e) syllabus non-completion. Although students' entry behavior in this study was discussed, poor performance was blamed on the negative effects of an education system, embedded institutional discriminatory teacher behavior, and less conducive learning environment. Although American classrooms and education systems cannot be overly compared with the distant South Africa, mathematical concepts are universal across the board, and South Africa experiences similar racial issues that affect schools as does the U.S.

In the U.S., general underperformance in mathematics has been attributed to the averaging of extremely low scores with high scores. Using the racial achievement gap as an example, data from National Assessment of Educational Progress (NAEP) show that by 8<sup>th</sup> grade only 37% of White students and 47% of Asian American students are proficient in mathematics, compared to 13% of Latino students and 9% of African American students. When scores are averaged, a different picture of each racial group's performance is painted. The assigned national score reflects none of the racial group's achievement level.

Darling-Hammond (2010) observed that the average of White and Asian students scores in PISA were significantly higher than the national average in both reading and mathematics. The study further observed that the racial and socioeconomic gap in mathematics and reading achievement in the U.S. was the largest in the diversity gaps category among all OECD countries. This means that achievement disparities are better discussed in terms of race and

socioeconomic status, which is intertwined for the disadvantage of African American and Hispanic students.

Flores (2007), while examining disparities in mathematics education as an achievement or opportunity gap, claimed that the Latino and African American 12<sup>th</sup> grade mathematics students perform as 8<sup>th</sup> grade White students. Averaging all American students' score for purposes of international ranking seems a misrepresentation of all students. The achievement gap by race, despite having fairly narrowed twenty years ago, has remained constant since 1998, and in some cases has been widening. The study posits that the underachievement in mathematics may not be as pervasive as statistics seem to indicate, because the dismal performance is among specific groups, who should be focused on. Specific intervention should be so directed. Nevertheless a national picture is needed for comparisons with the other developed nations.

In the NAEP's Trial Urban District Assessment (TUDA, 2011), researchers observed that most of the large cities with disproportionately higher non-white populations scored lower than the average of large cities that participated, at both 4<sup>th</sup> and 8<sup>th</sup> grade mathematics assessment. The large cities include: Atlanta, Baltimore City, Chicago, Cleveland, Detroit, District of Columbia (DCPS), Fresno, Los Angeles, Milwaukee and Philadelphia. In Cleveland Ohio, for example, where racial distribution is 40.4% White, 52.5% Black and 8.1% others, there was no significant change in either 4<sup>th</sup> or 8<sup>th</sup> grade mathematics achievement over the past four assessments, which has remained below the national and large districts performance. One may argue, then, that low scores are due to the size of the American economy with great diversity in environmental, social, cultural and cognitive levels and differences in state curricula which is not comparable with almost homogenous competitors like Shanghai, Finland or Korea.

The PISA assessment of 2009 also showed a racial factor in mathematics achievement. Peterson et al. (2011) wrote that 42% of White, 11% of Black, 15% of Hispanic and 16% of Native Americans students are described as proficient. But more than 50% of the students of the Asian and the Pacific Island origin were similarly classified. A comparison of the performance of White students in the U.S. with other countries showed that, although the proficient 42% of White American students is significantly higher than most minorities; this is much lower than the students in 16 other countries that participated. The study stated;

A better than 25-percentage-point gap exists between the performance of U.S. White students and the percentage of *all* students deemed proficient in Korea and Finland. White students in the U.S. trail well behind all students in countries such as Japan, Germany, Belgium, and Canada (p.10.)

This implies that underperformance in mathematics is comparatively higher in the US than other developed countries regardless of the student demographics.

General mathematics achievement shows signs of being significantly influenced by the substantive minority population in the US, which performs dismally, thus affecting the average used in international comparisons. Minority poor performance is often associated with poverty, linguistic proficiency, socio-cultural capital and socioeconomic status. Flores (2007) argued that studies that invoke race and gender only make the situation worse because they tend to perpetuate prejudice and stereotypes that continue to enhance the achievement gaps. Instead, she concurred with Strutchens & Silver (2000) in concluding that African American and Latino students are not as likely as White students to have teachers who emphasize non-routine problem solving and reasoning, teachers with access to computers, or teachers who use computers for simulations and applications. Flores (2007) calls this unequal access to learning opportunities an

“opportunity gap” that manifests as an achievement gap. Both Flore (2007) and Peterson et al (2011) concur that underperformance generally persists and that it is attributed to causes other than student characteristics.

Howley & Gunn (2003) claimed that, because mathematics is arguably the most teachable subject, the achievement gap can only be attributed to other causes like resource allocation. Their study concluded that the observable unequal access to learning resources by locations puts rural schools at a disadvantage. The study also compared poverty levels between rural and urban districts and observed significant gaps. The study concluded that children who grow up in poor neighborhoods are disadvantaged, especially in the learning of mathematics, because rural areas do not retain highly qualified teachers, and a higher percentage of students are likely to be taught by non-certified teachers or teachers who did not take mathematics as a core course in college.

Most of the studies have attributed the poor performance to the factors outside of the students. Motivational factors are scales that are very personal to individual students. They can be influenced by psychology, counseling and motivation professionals. This study focuses on mathematics achievement from additional angles: students’ self-efficacy, motivational attributes, gender and race. However, socioeconomic status cannot be ignored in a discussion of achievement. Most of the achievers and non-achievers attribute their situations to socioeconomic status (Darling-Hammond, 2010). The next section revisits the discussion on socioeconomic status.

#### 2.4 Socioeconomic status and education

A useful indicator of socioeconomic status has been whether or not a student qualifies for free or reduced price lunch in public schools. According to the United Nations International

Children's Emergency Fund (UNICEF), children living in homes where disposable income, when adjusted for family size and composition is less than 50% of median disposable household income for the country concerned are said to be living in poverty. By this definition, in 2012, 22% (16.2 million) of the children lived in poverty in the U.S. According to OECD, a child is described as “deprived” if he or she lacks two or more of a list of 14 basic items, such as three meals a day, a quiet place to do homework, educational books at home, or an Internet connection. Socioeconomic status has often simply indicated a level of poverty. However socioeconomic status as used in this study is an indicator derived from parents’ education, income, and occupation prestige. This measurement is usually used to denote an individual’s or family’s rank on the social and economic hierarchy (Ozturk & Singh, 2006).

Socio-economic status is one of the most important factors affecting education. Children in low socioeconomic status homes miss out on parental involvement in most of their activities, especially academic related activities. While parental involvement in itself does not lead to higher academic achievement, involvement influences behavior, controls choice of activities, and trains responsibility (Domina, 2005). Parents in the higher socioeconomic groups not only help their children with their academic work, but can also afford the extra books, technology and other resources their children need for their academic pursuits. Although many argue that these do not necessarily translate to high achievement, Milne & Plourde (2006) found out that educational resources and influences were two of the characteristics that parents of low socioeconomic status, with high achieving children had in common. Milne & Plourde (2006) concluded that high achieving students, from low socioeconomic status, had parents who prioritized the provision of educational resources, deliberately directed study, helped with school work, and controlled amount of television time for their children.

Socioeconomic status defines relationships with the children, community, school and work. Most relationships form from shared experiences. Milne & Plourde (2006) observed that parents in low socioeconomic status, whose children were high achievers, strived to form respectful relationships with adults—especially partners and spouses— that defined social boundaries for children, supported the children, encouraged openness, and were resourceful in times of challenges. Despite many hours away at low paying jobs, the parents strived to spend quality time with family. People of higher socioeconomic status have such relationships by virtue of their neighborhoods, occupations, and fewer hours at work, and they use them to advice and influence decisions for and by their children at school (Ozturk & Singh, 2006). In most cases these relationships naturally develop as they connect in paid events, participate in community affairs and are sought for their resourcefulness. Not only do their children learn from such involvements, but their parents and other adults become role models, mentors and advisors. Positive relationships are core in academic achievement and self- perception. High socioeconomic status comes with real, social, cultural and human capitals that start the children academically ahead of the lower cadre inevitably creating a lasting achievement gap (Engberg & Wolniak, 2010).

A mother's education level is a significant contributor to academic achievement. For the high socioeconomic status cadre, it becomes handy as they serve as informal teachers for their children out of school. Other parents in this cadre opt to live as guides at home, and unpaid teacher aides at school instead of taking employment. Educated mothers develop positive self-perceptions such as competence in their line of training, academic self-efficacy because of their achievements, and both self-esteem and self-worth because of their occupations and the



community they live in (Bogard, 2005). The social capital in a mother's education trickles down to the children and translates into their own self-perceptions and academic achievements.

In the lower socioeconomic classes the mothers are often not informed enough to be resourceful to their children, often work long hours , in low income jobs, are more likely to be unemployed, are more likely to use or live in homes with drug users, are more likely to be single with many children, and usually live in low income neighborhoods. Children in poverty areas are four times more likely to be diagnosed with a disability than those from non-poverty areas, and are likely to be underserved with the physiological needs such as food, housing and decent clothing, making it difficult for them to focus on education (Casanova, Garcia-Linares, Torre & Carpio, 2005). The children do not get their own time for school work, and are likely to develop unhealthy relationships, with peers and other adults. Milne & Plourde (2006) reiterated that mothers of low socioeconomic status, whose children were high achievers, emphasized the importance of education to their children, regretted lost opportunities while in school, planned to or were pursuing further education to improve their situations, and blamed low motivation for their failures in school. For mothers, therefore, the challenge is developing an appreciation of the role of education and expressing such values before their children.

By the official definition of poverty, it is difficult for a diverse and large economy like U.S. to be without people described as poor. Despite the high correlation between socioeconomic status and academic achievement, programs that redirect and prioritize certain educational values and perceptions can ensure that every child is taught and learns (Milne & Plourde, 2006).Comparatively, most American classrooms have enough for every child to learn, especially mathematics, but interfering variables such as disengagement, distractions and poor

discipline vary from school to school. Unfortunately, these educational detractors correlate highly with socioeconomic status.

Reaching out to parents, especially mothers to appreciate education and be motivators at home, is one method of raising achievement. This can be done through both formally and informally educating and involving the parents, especially the mothers, in learning and teaching activities. Fan & Williams (2010) saw a significant relationship between parental involvement, motivation and achievement. This study explores the relationships between socioeconomic status and motivational factors, gender and race, and mathematics achievement.

### 2.5 Relationship between mathematics achievement and self-efficacy

Pajares (2002) defined self-efficacy as “people’s judgments of their capabilities to organize and execute courses of action required for attaining designated types of performances” (p.3). Self-efficacy is a personal construct about self. It is domain specific in that one may feel efficacious in one area and not in another. Domain specific efficacy is also not necessarily constant over time. In education, there is general academic efficacy and subject specific efficacy. Mathematics self-efficacy is the person’s belief or judgment about his/ her ability to correctly solve mathematics problems.

Self-efficacy construct is directly or indirectly determined by both contextual and situational factors (Gaddard, Hoy & Hoy, 2002). For example students who are efficacious in mathematics may feel uncertain of their performance in testing under certain conditions (say timed tests), or type of questions (multiple choice or structured) yet others may be anxious when they know that the scorer is not their teacher (Nicolaidou & Philippou, 2012; Matsui, Matsui & Ohnishi, 1990). This means that there is a given level of efficacy about every task, at any given time, and it can be altered by certain conditions.

Bandura (1986) observed that beliefs are very highly related to outcomes as they psychologically act as self-prophecy. If one believes that it is futile to work on mathematics because it is “hard,” then one is likely to fail. Research has shown that self-efficacy is an important determinant of achievement (Schunk, 1989; Zimmerman, Bandura & Martinez-Pons, 1992).

Mathematics self-efficacy directly influences students’ expectation of success and their valuation of the subject. If students’ beliefs about their ability to do mathematical tasks are low, they will tend to put little effort into overcoming the challenge, and instead attempt to rationalize it away as less important. They tend to seek ways of doing without mathematics by attaching little value to the subject (Meece, Wigfield & Eccles, 1990).

A longitudinal study observing students in fifth, eighth and eleventh grade, conducted by Zimmerman & Martinez-Pons (1990) observed that the students accurately rated their abilities in tackling mathematics, and that the accuracy increased as they advanced in school. Furthermore students’ attempts to strategically control their effort to learn mathematics were directly influenced by mathematics self-efficacy. Thus students with high mathematics self-efficacy were more likely to choose to study mathematics and stay on it until they have achieved a certain level of understanding or achievement.

According to Linnenbrink & Pintrich (2003), self-efficacy forms the foundation of human motivation, well-being and personal accomplishment. People have no incentive to persevere with difficult tasks if they believe that their actions will not lead to desirable outcomes. Research has proved Bandura right on the role of self-efficacy in productive thought or depression, self-depreciation, pessimism or optimism, self-motivation, perseverance and life choices, the study concludes.

Self-efficacy has also been critical in studies on self-regulation. Bandura (1997) argued that individuals have some influence or control over what they can accomplish. Therefore individuals form intentions, set goals, anticipate possible results, monitor and regulate actions, and reflect on their personal efficacy. The ability that helps to build the capacity for self-regulation is referred to as human agency (Bandura, 1997).

Bandura (1997) further added that people's actions, levels of affection and motivation are based more on what they believe rather than objective truth. People do what they believe they can do with their knowledge and skills, but not what they can (potentially) do. Thus Bandura concluded that behavior is better predicted from individual's beliefs rather than their achievement. Specifically in education, individuals' beliefs are better predictors of academic achievement than previous academic achievements, knowledge or skills (Pajares, 2002).

Self-efficacy beliefs also critically determine how well knowledge and skills are acquired (Bandura, 1997; Pajares, 2002). Early theorist had conjectured that affective, episodic and evaluative nature of beliefs makes the same beliefs filters through which new phenomena is interpreted (Pajares, 1996). That is, the amount of emotional attachment or feelings, coupled with some satisfaction that comes with success (say honor roll, or public acknowledgment) and reflections on belief systems are perspectives that influence self-efficacy belief formation.

Self-efficacy beliefs play a role as determinants of the expected outcomes. Confident students in academic pursuits and social interactions expect high marks and positive social encounters. Conversely, students who are not confident in academic pursuits will expect failure, and those unsure of their social skills will expect rejection or ridicule long before the encounter (Zeldin & Pajares, 2000). Such expectations, though totally different from reality, will influence the environment (social or physical). Expectations also influence reaction to outcomes. Thus,

highly efficacious students who fail will question themselves and follow up to find why, while those who already believed they would not pass will not be surprised when they fail.

Self-efficacy is both a personal and a social construct. Hoy & Hoy (2000) observed that teacher collective efficacy is "the groups' shared belief in its conjoint capabilities to organize and execute courses of action required to produce given levels of attainments" (p.482). It is a common belief among group members that they have capabilities to positively impact student achievement. But students' collective self-efficacy may be viewed as a common belief among students that they are capable of certain achievements from shared experiences or environments. If a group (for instance, a school) has common belief in their capabilities as a school, then they have a collective efficacy.

For example, many schools that have performed well in their academic pursuits form collective efficacy beliefs while others, whose pass rates have been dismal, influence members to doubt their capabilities, resulting in low self-efficacy. Students' collective efficacy is different from teachers' collective efficacy. Thus student groups, that by whatever means develop mathematics self-efficacy, are likely to perform better in mathematics.

Bandura (1986) wrote that self-efficacy can affect behavior in four main ways; (1) choice, (2) effort and persistence, (3) thought patterns and emotional reactions, and (4) whether the individuals will be a producer of behavior or a foreteller of behavior. People will tend to choose activities in which they feel efficacious and avoid those where they doubt their capabilities (Zeldin & Pajares, 2000). In mathematics learning, students who doubt their abilities are likely to avoid the subject, and are likely to do little to learn the subject. Such behavior partly explains why students who perform poorly continue performing poorly. They never attempt to

learn the subject. Unless people believe that their actions will lead to desired outcomes, they have little incentive to engage in the activities.

Self-efficacy beliefs also determine how much effort one can expend and how long one can persist on an activity. If self-efficacy beliefs are stronger in an individual, he or she is likely to put in more effort, persevere longer and, in case of adversity, remain resilient (Bandura, 1986). Pajares (2002) added that people with high self-efficacy approach difficult tasks as challenges to be overcome rather than threats to be avoided, and also recover quickly from failures. Therefore, students with high self-efficacy create an opportunities to interact more with the subject, and learn what they could not have learned without persistence and effort.

Self-efficacy beliefs influence thoughts and emotions (Cassady & Johnson, 2001). Highly efficacious people approach difficult tasks with serenity, while those with low self-efficacy may experience anxiety, stress and, depression, and perceive limited options of how the problem can be solved. Mathematics self-efficacy not only significantly determines how much preparation is done through practice and assignments, but also controls the detrimental contextual factors like anxiety, stress and depression. These factors, especially anxiety, have been negatively associated with academic achievement.

Lastly, Bandura (1986) stated that “people, who regard themselves as highly efficacious act, think and feel different from those who perceive themselves as highly inefficacious. They produce their own future, rather than simply foretell it” (p.395). Indeed ones belief in self leads to innovative, creative and inventive activities that enhance learning, creating new ideas and inventions.

Other studies have reinforced reciprocal determinism theory, by showing that self-efficacy and performance have a reciprocal relationship. Pajares (2002) points out that successful

performance in preceding tasks creates efficacious beliefs in future assignments, while high self-efficacy encourages individuals to approach task as challenges to be overcome rather than as obstacles to be avoided, leading to readiness to succeed. Yoon (2002) believes that in mathematics, teachers should help students develop efficacious beliefs by guiding them to mastery from simple to complex concepts, through means such as calculated verbal persuasion and positive feedback, peer teaching and the creation of classroom environments that are free of anxiety, depression and frustration (Yoon, 2002).

### 2.6 Sources of self-efficacy

Internal and external sources of information form the basis of people's assessment of their abilities (Bandura, 1997). As a result self-efficacy beliefs are formed by interpretation of gathered information. According to Bandura, (1997), individuals develop their self-efficacy beliefs relying on four types of information. The first, mastery experiences, is where an individual believes in his or her capabilities and competence because of successfully completing similar or related activities. Experiencing success in an activity creates a belief in individuals that they can complete similar activities in future. Students who have performed well in mathematics are likely to have high self-efficacy. After repeated success, occasional failure is less likely to affect the efficacy level. Failures overcome by effort and persistence increase one's self-efficacy and once it is established, it is generalized to similar tasks. Failure in a task that one is highly efficacious in is likely to be attributed to situational or contextual factors other than incompetence. Mastery experience, as a source of self-efficacy beliefs, is the most impactful among the four (Bong & Skaalvik, 2004)

The second source of information for developing self-efficacy beliefs is vicarious experiences, especially modeling and social comparison. Individuals feel efficacious in tasks

when they observe their peers being successful in similar tasks. Similarly, if they observe their peers failing, they may doubt their own ability. People convinced vicariously of their inefficacy are inclined to behave in ineffectual ways that, in fact, generate confirmatory behavioral evidence of inability (Bandura, 1986). This is especially impactful in the educational setting, where a student's demonstration of mathematics or even general academic fluency ignites in others a sense of urgency to learn just like their peers. The more the model is similar to the observer, the greater the impact of the vicarious experience on self-efficacy belief formation (Zeldin & Pajares, 2000).

The third source of information for self-efficacy belief formation is social encouragement, feedback and praise (all referred to as verbal persuasion). Positive appraisal and encouragement have been known to raise self-efficacy when they are realistic (Zeldin & Pajares, 2000). Verbal persuasion is impactful when the credibility, expertise and trustworthiness of the persuader are high. Social persuasion is very detrimental both to self-efficacy and achievement, and can discredit the persuaders when the appraisal becomes clearly unrealistic (Bandura, 1986). Both Bandura (1986) and Zeldin & Pajares (2000) hold that verbal persuasion is more likely to undermine self-efficacy than to raise it, because in most cases it will seem unrealistic. Teachers should be cautious of their feedback in terms of comments and praise, lest they be detrimental in enhancing self-efficacy.

Finally, the fourth source of information for self-efficacy belief is the somatic and emotional states, also referred to as physiological states. According to Bandura (1986), people live in psychic moments of their own making, and therefore physiological states such as anxiety, depression, and emotional attachment to the outcomes and activities influences level of self-efficacy beliefs. Melancholic physiological states will lower self-efficacy, just as positive states



of mind such as good mood will raise self-efficacy. However, research has shown a reciprocal influence of the physiological states of the body and self-efficacy interaction (Zeldin & Pajares, 2000). If physiological states can be improved, they will raise self-efficacy, and if self-efficacy is raised by any means, negative physiological states will be reversed.

It can then be inferred that self-efficacy beliefs in mathematics learning are invaluable. When raised and kept high, they are likely to impact mathematics achievement. Mathematics achievement and self-efficacy are also viewed as having a reciprocal relationship (Linnenbrink & Pintrich, 2003). Therefore, teachers should be careful with students in their formative years of learning mathematics, and they should offer manageable tasks that can be successfully accomplished by learners in order for them to build self-efficacy. Once self-efficacy is high, students are likely to develop positive attitudes, self-regulate and persist on mathematics, which will in turn enhance performance and high self-efficacy.

One of the effective aspects in classrooms and among learners that deserve attention include creation of a learning environment that enhances mathematics self-efficacy (mathematics self-efficacy is directly related to performance (Phelps, 2010; Gutman, 2006)). Environments that enhance positive goals formation have been positively associated with mathematics self-efficacy (Jagacinski et al., 2010). Other effective aspects include, identification, encouragement and the creation of an intrinsically motivating learning environment (intrinsically motivated learners are persistent, perform better, work harder and are more focused (Schunk, Pintrich & Meece, 2008)).

## 2.7 The meaning of motivation

A number of definitions of motivation in counseling, education and psychology abound. Schunk, Pintrich & Meecee (2008) define motivation as the process whereby goal-directed activity is instigated and sustained. Hannula (2006) posits that motivation is the tendency to do some things and avoid doing some others, while Sasson (2010) describes motivation as the inner power or energy that pushes toward taking action, performing and achieving. Motivation has much to do with desire and ambition, and if they are absent, motivation is absent too.

Dicknison (1995) wrote that motivation are the options people take as to what experiences or goals they will approach or avoid and the amount of effort and persistence they will put forth for it. All of these definitions imply that motivation is that which creates an urge to start or avoid starting and endeavor, and persist to a desirable end. In the context of this study, motivation is the purposeful striving, the skill and will to learn mathematics. Accordingly students who are interested in learning or improving their skills are expected to display motivated behavior evident through their choice of activity, effort and persistency on the activity, and will and preparedness to learn (Schunk et.al. 2008).

The role of motivation in the teaching and learning of mathematics cannot be emphasized enough. Hannula (2006) observed that students in a mathematics classroom are motivated to do many things, more than the assigned and expected. In order to understand student behavior in classrooms teachers need to increase their understanding of what motivates, regulates and controls students' actions. This is necessary for planning class activities that elicit motivated behavior towards learning generally, and mathematics in particular. Harkness (2007) added that there is much to learn about the connection between motivation and learning theories through a careful analysis of students' reflections, about themselves, their goals, and courses they are

taught. In fact getting students to be enthusiastic about learning will, not only benefit the students whose lives teachers mold, but be both a pleasant experience and an effective classroom management strategy.

There are many theories on motivation. In this section, the researcher discusses the difference between intrinsic and extrinsic motivation, how they relate to each other, and other factors in learning and teaching mathematics.

### 2.71 Intrinsic vs. extrinsic motivation

Intrinsic motivation refers to the urge to engage in an activity for its own sake. According to Schunk et.al (2008), intrinsic motivation is the goal directed activity instigated and sustained by an internal desire. Examples include the urge to perform a task because it is morally right, or for the sake of personal pleasure, or to learn a skill. In mathematics classrooms, students whose desire to learn mathematics comes from a desire to know it, a belief in its importance, and a pleasure in learning it, can be said to be intrinsically motivated. Intrinsic motivation originates from the satisfaction inherent in the action (Deci & Ryan, 2002).

On the other hand, extrinsic motivation is the urge to engage in a goal directed activity instigated and sustained by factors unrelated to the activity. Students who want to learn mathematics to be top of the class, to get a reward, earn better grades or because they want to please their teachers or parents are extrinsically motivated. This means that, without the unrelated goal, the students won't be interested in the learning activity. In extrinsic motivation the outcomes are unrelated and separable from the action (Deci& Ryan, 2002).

Although extrinsic and intrinsic motivations are not mutually exclusive, nor do they lie on a dichotomous continuum, the Self Determination Theory (SDT) brings out the differences that can arise in learning outcomes of students, depending on whether they are intrinsically or

extrinsically motivated. According to the SDT there are three basic psychological needs: competence, relatedness and autonomy.

*Competence* is the feeling of effectiveness in one's continuous interaction with the social environment, and experiences of opportunity and expression of one's capability. The need for competence leads people to seek challenges that are optimal for their capacities and to persistently attempt and enhance those skills and capacities Deci & Ryan (2002).

In a mathematics classroom, there is a need to develop the feeling of competence. Not only does this encourage attempting even difficult and challenging problems, but it also fosters confidence in sharing information, a core aspect in learning mathematics and in general socialization. Students whose competence need has been achieved are more likely to respond in class, attempt average and above average tasks, offer help to other students (individually and/or in groups), persist, consult and research (Watt 2004). Individuals need to feel competent in their interactions with others, both with tasks and activities, and within the larger community. From the evolutionary point of view, the lack of competence points to the un-likeliness of survival (Schunk et al, 2008).

Intrinsically motivated competence persists, whereas extrinsically motivated competence wanes with the withdrawal of the external force that sustained it. Furthering the feeling of competence in learners is likely to foster intrinsic motives for learning. If a student feels competent in engaging in mathematics activities, then he or she may want to put more effort, persist on learning the subject, and finally achieve even without expecting rewards or praise (Schunk et al, 2008; Deci & Ryan, 2002). Competency may vary depending on whether one is intrinsically or extrinsically motivated.

*Relatedness* is the need to belong to a group, sometimes called “need for belongingness” (Schunk et.al 2008). Deci & Ryan (2002) describes relatedness as the feeling of connectedness with others in a way of either caring for or being cared for by them. It is the sense of belonging to both other individuals and one’s community. Students who feel “left-out,” when the rest of the students seem to be following class instruction, have relatedness need. Relatedness also means a teacher student interaction that fosters a feeling in the student that he or she belongs in that classroom, and that the teacher values his or her being there (Reeve, 2010).

Students whose need for relatedness is met are likely to be intrinsically motivated (Schunk et.al 2008). In mathematics learning, content that is relevant to society, related to other subjects, applicable in other fields, and that is taught with care is likely to be learned intrinsically. Although good grades, rewards, praise and honor rolls, among other extrinsic motivators, may be the aim of some students whose need for relatedness is met, if those extrinsic motivators are withdrawn, the students are more likely to withdraw interest in learning mathematics.

*Autonomy* is the freedom to do what one wants to do without feeling that they are controlled by another person or people. Autonomy, according to Deci & Ryan (2002), means being seen as the origin of one’s own behavior. The need for autonomy refers to the need to feel in control, and to choose and initiate behavior. Even when behavior is influenced by others, autonomy is the feeling that the outcome is attributed to the actors. If a mathematics teacher insists on having her students doing a mathematical problem using her prescribed methods, with a calculator, at a given time and for a determined period of time, the need for autonomy is not addressed.

Reeve (2010) wrote that teacher instruction can either be autonomy-supportive or controlling. Teachers whose instruction is autonomy supportive are likely to develop intrinsic motivation among learners. The study observed that students achieve highly, learn conceptually and stay in school in part because their teachers support their autonomy rather than control their behavior. The main characteristics of autonomy supportive teachers are; responsiveness, flexibility, and supportiveness. Such teachers also motivate through interest and curiosity development in students. While autonomy supportive teachers develop intrinsic motivation in students, controlling teachers may resort to extrinsic rewards to sustain their control.

Self-determination requires that people accept their strengths and limitations, be cognizant of forces acting on them, make choices, and determine ways to satisfy them. Such a resolve derives from an internal will, and musters energy not from unrelated external drives. This implies that self-determination is very intrinsic. Furthermore self-determined mathematics learners have high self-esteem and high mathematics self-efficacy; attributes that enhance intrinsic motivation, Schunk (2008).

Rewarding students in classrooms is the basic extrinsic motivator available to many teachers. Although intrinsic and extrinsic motivation are positive attributes to learners, Lepper & Hodell (1989) reported, that tangible rewards (extrinsic motivation) of any kind lead to decreased intrinsic motivation, as long as they were expected and their receipt is required for engaging in the activity. Although initial studies (Deci, 1975) indicated that verbal or praise (non-tangible rewards) enhanced intrinsic motivation, the emphasis on the expectation of the praise while performing the activity may actually lead to decreased intrinsic motivation.

A mathematics classroom, where a teacher is always rewarding the achievers, ranking the students, and praising whenever positive behavior is exhibited, is likely to instill behavior

expectant of rewards, thus extrinsic motivation. This can neither be permanent nor consistent over time, since teachers may change, and different teachers have different styles. It may undermine intrinsically motivated, non-achieving or simply average learners, because they may never be rewarded at all. Even the intrinsically motivated high achievers may start expecting extrinsic rewards, ultimately undermining intrinsic motivation. In conclusion, motivation (intrinsic or extrinsic) has a critical role in learning. Because of the unreliability of extrinsic motivation, it is better to strive for intrinsic motivation.

### 2.72 Rewards

The expectation of rewards has been known to make people work hard. For example, well performing sports stars expect higher pay, productive employees expect promotions, successful marketers expect bonuses, and the promise of a pleasant event (like free time on computers) makes some students stay on assigned tasks, that they would have been reluctant to focus on without such a promise.

However, rewards have their downside, especially on intrinsic motivation, and generally on successive performance. Firstly, Lepper, Greene and Nisbett (1973) observed that, children with an interest in drawing, after being rewarded for their initial drawing, exhibited diminishing interest in their succeeding drawing assignments. The study concluded that intrinsically motivated individuals may lose their motivation if they are rewarded for what they like to do. The feeling of doing the work for the reward undermined their original desire to work.

Secondly, the over-justification hypothesis holds that when working on a task to obtain a reward, workers are likely to view their actions as extrinsically motivated. Offering people a reward to work, on a task they already enjoy, provides more than adequate justification (over-justifies) for their participation. When the reward contingency is no longer in effect, people lose

their justification and motivation for working on the task (Schunk et al, 2008). If the rewards for school work are so crucial, they are likely to undermine the purpose for coming to school.

Thirdly, the cognitive dissonance theory holds that people strive to maintain consistent relations among beliefs, attitudes, opinions and behaviors. If cognition among these factors is not consistent, there dissonance develops. People may reduce dissonance by changing beliefs, qualifying cognitions, or downgrading the importance of certain cognitions, (Schunk et al., 2008). There may be discrepancies between cognition of behavior and cognition of belief. Students may downgrade the importance of learning (or the reward), or they may qualify the behavior by requiring rewards for learning, or they may deny outright the belief that school is for learning.

Finally, according to Deci (1975), every reward (including feedback) has two aspects: a controlling aspect and an informational aspect. The aspects provide the recipient with information about his competence and self-determination. Accordingly Schunk (2008) observed that if the controlling aspect is more salient, it will initiate the change in the perceived locus of causality process. If the informational aspect is more salient it will initiate the change in feelings of competence and self-determination.

These dual aspects of rewards combined with teachers' limited awareness of the recipients' perceptions of the rewards, calls for thorough understanding of how, when, and where to reward students, as well as what to reward them with and for. The diversity of students in classrooms complicates the effective use of rewards as a motivator. It is more worthwhile to seek to develop intrinsic motivation among learners, than to rely on extrinsic motivators.



## 2.8 About the ELS-2002 database

The ELS-2002 survey was conducted to monitor how a nationally representative sample of high school students transitioned to college and careers. Over 16,000 students in 1,954 high schools were followed for a period of 10 years. The database is rich in variables and is longitudinal. Several studies are based on the database. This section reviews some of them.

Carbonaro & Covay (2010) studied student achievement in relation to school factors during a standards based educational era of NCLB. The study observed that mathematics gains between 10<sup>th</sup> and 12<sup>th</sup> grade were higher in Catholic and other secular private schools than in the public schools. In addition the study revealed that non-public school students took more mathematics courses, and the achievement gaps between the types of schools were more pronounced in advanced mathematics courses.

The study attributed the achievement gaps to the differences in the number of courses taken between 10<sup>th</sup> and 12<sup>th</sup> grades. The study, did not however, take into consideration the students' roles based on their attributes and behaviors that could influence mathematics performance. The current study identifies relationships with other factors that could be considered in enhancing enrolment in advanced mathematics courses to improve mathematics achievement gains, for example effort and persistence and individual determination are student variables that are controlled by the students themselves that are expected to impact achievement.

In a study of effects of high school contexts on post-secondary enrolment, Engberg & Wolniak (2010) observed that access to parents, peers and college-linking networks influenced college enrolment especially, through acquisition of cultural, human and social capital. These capital(s), the study claims, are built through socioeconomic and academic preparation roles played by high schools. In a related study, Fan & Williams (2010) explored the relationship

between motivational factors (self-efficacy, engagement and intrinsic motivation) and parental involvement for 10<sup>th</sup> grade students. They observed that parents' contact with school officials over students' misbehavior had a negative effect on all of the motivations factors.

However, both parents' aspirations for their children, and school contact with the schools on other issues, had strong positive effects on students' motivational factors. Parental directions, in terms of rules on time spent on watching TV at home, also positively related with engagement and intrinsic motivation towards mathematics and English. This is consistent with other research that positive parental involvement with children, psychologically prepares students for learning in school, and boosts their self-construct beliefs.

Understanding the *nested* nature of school, home, and student factors is desirable in designing intervention programs to enhance engagement and motivation. Furthermore, studying other social and psychological self-constructs based on the subjects of this study will create insight into academic achievement and related issues. The current study will complement the work of Fan & Williams (2010) in methodology and consideration of different motivational factors.

Sciarra (2010) investigated the predictive factors in intensive mathematics course taking at high school. They reported that students' expectations, parents' aspirations, socioeconomic status and race were significant predictors of course taking. Carbonaro & Covay, (2010) also studied the relationship between mathematics gains between 10<sup>th</sup> and 12<sup>th</sup> grade, and concluded that the gains were a function of the intensity and level of mathematics taken. The two studies imply that, if students can be encouraged to enroll in more mathematics courses and of higher levels, then they are more likely to improve on their achievements.

Gemici & Rojewski (2010) studied some of the factors that influence the success of at risk students in high school. At-risk students are defined as youths who are likely to fail in a major task that is necessary for a better life (Kominski et al., 2001). In a school setting, these youth are unlikely to graduate and join some postsecondary institution and/or work. The authors reported that participation in co-operative education had a significant effect on the at-risk students' plans for higher education, whereas work placement did not. Co-operative education was defined as a placement and participation in a focus group aimed at giving and getting support to successfully transition to postsecondary education.

Alano et al. (2010) documented a relationship between Hispanic students' academic attainments their parents' immigrant status and levels of education. Although they observed Hispanic/White achievement gaps in mathematics and other subjects, they also observed that Hispanic parents were generally experiencing an unexplained handicap in transmitting their educational advantages to their children compared to white parents. They concluded that unequal ability to confer the educational advantages to their offspring combined with changing population composition is the main cause of the achievement gaps.

In a similar race focused study, Peguero (2010) used the same data to profile Latino students' involvement in extra-curricular activities. Immigration status, English proficiency and geographic location were pertinent in determining Latino student participation in extracurricular activities. The study argues that participation in school activities has a positive relationship with academic performance. This simple regression modeled study can be extended to finding how exactly the factors interact, to determine whether a student participates or not, with more than one level analysis.

Using the ELS-2002 data, Wells (2010) studied the role of school composition on immigrant children's educational expectations. The study concluded that immigrant children's educational expectations are affected differently from non-immigrant children in ways that are contradictory to theory and policy. Specifically the study observes that comparative and normative theories of school effects are not accurate, or at least not in the same degree as they are for non-immigrant children. Students of diverse backgrounds should be viewed and taught differently. It may be extended even to the emotional and motivational states which are different.

Weiss, Carolan and Smith (2010) studied the relationship between school size, student engagement, and mathematics performance. Reduction of school sizes, to address adolescent engagement and academic achievement, is proposed in improving performance. Although the measures were highly related, the study reported that moderately sized schools and classes provide the highest engagement level for students, with sizes above 400 students starting to be harmful to engagement. They further observed that different sizes affected varying demographic groups differently, which complicates the problem of prescribing an all-round best size.

## 2.9 Conclusion

The ELS-2002 database is very rich with variables, and studies that can contribute to solving educational problems can be based upon it. With the last follow-up data yet to be included at the time of this study, it is expected that more relationships will be considered, and other studies based on the database. This study is part of the many exploring relationships that have not previously been considered for the purpose of creating new knowledge.

This chapter reviewed literature on the importance of mathematics and why the concern about its performance, and then related mathematics performance to the chosen variables of the study (mathematics achievement and self-efficacy). It explored the relationship between self-

efficacy and academic outcomes, specifically mathematics self-efficacy and mathematics achievement, and the sources of self-efficacy. Lastly it looked at some recent studies using the ELS-2002 data base which were related to mathematics, motivational factors and achievement. Research on mathematics underachievement not only in the U.S. but also across the globe is likely to continue as the problem persists. The next chapter discusses the design and methodology of the study.

## CHAPTER THREE

### METHODOLOGY

#### 3.1 Introduction

This chapter is a discussion of the design and methods utilized to carry out the study. The first section is a brief introduction to the chapter. Section Two discusses the sources of data, methods, purposes, population and time of data collection. Section Three describes the sampling procedure and the resulting sample. Section Four is a description of the variables. Finally, Section Five discusses the data analysis techniques utilized in the study.

#### 3.2 Source of data

The Educational Longitudinal Survey (ELS-2002) data from the US Department of Education's National Center for Educational Statistics (NCES) at the Institute of Educational Studies (IES) is used in this study. ELS-2002 is a database rich in information collected four times from students, their teachers and parents, school principals, and directors of media centers, in a national sample of schools. Many studies are based on the ELS-2002 database. The nature and sources of the data were appropriate for a multi-level analysis. According to Raudenbush & Bryk (2002), analysis of subjects' measures within different groups fits a hierarchical linear model.

ELS-2002 surveys were conducted by National Center for Educational Statistics (NCES). NCES is mandated by the Department of Education to design and carry out surveys for the purpose of monitoring education trends and sectors in the US. According to the official documentation:

The National Center for Education Statistics (NCES) is the primary federal entity for collecting, analyzing, and reporting data related to education in the United States and other nations. It fulfills a congressional mandate to collect, collate, analyze, and report full and complete statistics on the condition of education in the United States; conduct and publish reports and specialized analyses of the meaning and significance of such statistics; assist state and local education agencies in improving their statistical systems; and review and report on education activities in foreign countries (NCES 2008-319, 2008).

ELS-2002 is one of the many large databases at the NCES with a substantial portion of the data unutilized, presenting opportunities for almost unlimited studies. For this reason, NCES trains and encourages students and other interested parties to base studies on these databases. The researcher in this study benefitted from two such training sessions. Furthermore, NCES is continuously collecting educational data of all kinds, and continues to train educational researchers, scholars, and students to access their databases for various studies.

The ELS-2002 was a longitudinal study designed to monitor the transition of a national sample of young people as they progressed from tenth grade through high school and on to postsecondary education and/or the world of work (ELS-2002). Along with many variables, the survey captured important school contextual variables such as regions, locations, sponsors, school sizes and climate. The initial survey was conducted in 2002, when the subjects were in 10<sup>th</sup> grade. There was a first follow-up in 2004, when subjects were in 12<sup>th</sup> grade and a second follow-up in 2006, when some of the subjects had progressed as far as second year in college.

The final follow-up was in 2012, representing a period of ten years in which the subjects were expected to have completed the full circle of school, college and work.

### 3.3 Sample

A total of 16,197 students, their parents or guardians, and both mathematics and English teachers responded in the initial survey. The schools were either sponsored by the public, Catholic or some “other” private entity. The schools were also classified as being either in rural, suburban or urban locations. The table below shows the distributions of the students according to gender, location and sponsor. A total of 827 (5%) had missing data in either gender, type of school or location of school, reducing the number of valid cases to 15,370.

Table 3.1: Distributions of the sample subjects according to gender, location and control sponsor

<i>Sponsor(contr ol)</i>	<i>Male</i>	<i>Female</i>	<i>Total</i>	<i>Percentage</i>
Public	5990	6102	12092	78.7%
Catholic	984	920	1904	12.4%
Other Private	679	695	1374	8.9%
Total	7653	7717	15370	
Percentage	49.7%	51.3%		100%
<i>Location</i>				
Urban	2513	2599	5112	33.3%
Suburban	3700	3713	7413	48.2%
Rural	1440	1405	2845	18.5%
Total	7653	7717	15370	
Percentage	49.7%	51.3%		100%



Additionally all of the students' English and mathematics teachers completed responses about each student and their school. Student socio-demographics were also included in the database. The respondents were drawn from 1,954 schools representing all parts of the nation. The table below is a cross-tabulation summary of school distribution by sponsor and location.

Table 3.2: Cross-tabulation summary of school distribution by sponsor and location

<i>Location</i>	<i>Public</i>	<i>Catholic</i>	<i>Other Private</i>	<i>Total</i>	<i>Percentage</i>
Urban	1255	67	52	1374	71%
Suburban	291	48	61	400	20%
Rural	130	4	38	172	9%
Total	1676	119	151	1946	-
Percentage	86%	6%	8%	-	100

The first follow-up completed in 2004 had the same second-level respondents for each student, but 12,400 students' responses were valid. This is because 1,100 transferred from their original schools, and another 1,300 were categorized as early completers or dropouts.

### 3.4 Variables

This study was a two level exploration of the relationships between mathematics achievement and mathematics self-efficacy, and students' motivational factors and socio-demographic factors. In level 1, motivational factors (individual determination, efforts and persistence, learner preparedness and extrinsic motivation) together with socio-demographic factors (race and gender) were used in models in which mathematics achievement and mathematics self-efficacy were dependent variables. The school factors (socioeconomic status, sponsor, location, and climate) formed the set of level 2 variables. Mathematics self-efficacy,

individual determination, extrinsic motivation, learner preparedness, effort and persistence, and school climate were continuous variables created through principal factor analysis with high reliability.

Although most literature discusses mathematics self-efficacy as a cause of change in mathematics performance, this study adopts Bandura's reciprocal determinism model perspective, which posits that behavioral and personal factors have reciprocal causal relationship. Mathematics performance and mathematics self-efficacy were perceived as dependent and determinants of each other. In this study, both were bundled with other independent variables as predictors of each other.

School contextual factors (school socioeconomic status, sponsor, location and school climate) were considered as constituting the environmental factors, the third component in the triadic reciprocal determinism model. Differences in these factors were perceived as presenting different environments. Their interactions however are perceived as being reciprocal to the behavioral and personal factors. This study utilized environmental factors in the level two model equations.

The study viewed student and school level factors in a two-level hierarchical relationship. Mathematics achievement, mathematics self-efficacy, effort and persistence, extrinsic motivation, individual determination, gender, race, and class preparedness were student variables (level 1), while school climate, sponsor and location were school variables (level 2).

1. *Mathematics achievement* was a measure of student's mathematics ability as indicated by a cognitive test given in spring of 2002 and 2004 when the subjects were in 10<sup>th</sup> and 12<sup>th</sup> grade respectively. In this study exit scores at 12<sup>th</sup> grade are used in all analyses.

2. *Mathematics self-efficacy* was created through principal factor analysis and standardized to a mean of 0 and standard deviation of 1. This scale is different from the ones used in Bagakas (2011), Johnson (2008) and Pajares (2002). A set of the five items used is listed in Appendix A. It was measured at 10<sup>th</sup> and 12<sup>th</sup> grade. Students missing data on any of the composing items were not assigned a score. This study uses the 12<sup>th</sup> grade mathematics self-efficacy for all analyses.
3. *Motivational factors*: The study utilized the following four scales as motivational scales: *extrinsic motivation, effort and persistence, class preparedness, and individual determination*. They were created through principal factor analysis and standardized to a mean of 0 and standard deviation of 1. The items used to create respective scales are listed in Appendix A.
4. *Gender* represented male and female in the analysis. They were always dummy coded male :1, Female: 0.
5. *Race* as examined in this study was in two parts: Black students' difference from all of the other students, and Hispanic students' difference from all of the other students. The Black student indicator was always dummy coded Black:0, Other:1, and Hispanic student indicator Hispanic:0, Other :1.
6. *Socioeconomic status* was composed using the following information: the mother's, father's and guardian's levels of education, their occupations' prestige, incomes, and descriptions of their household. The index was computed for every student and standardized to mean 0 and standard deviation 1. The school's socioeconomic status was the average of students' socioeconomic status in a school. It was used to produce a composite school socioeconomic status indicator. It was used at level-2.

7. *School Climate* was created through principal factor analysis and standardized to a mean of 0 and standard deviation 1. It was created from the principal teacher's responses to five items rating the learning conditions in their own school (see Appendix A). It was then assigned to every student, and also assigned to the respondent's school. In this study, school climate is utilized as a school (Level 2) variable.
8. *Location* was a Level-2 variable referring to whether the schools were in an urban, suburban or rural location. Because of the three levels. The analyses were done three times, dummy coded as Urban:0, Suburban:1; Urban:1, Rural:0; and Suburban:1, Rural:0.
9. *Sponsor* was also a Level-2 variable referring to whether schools were either public, Catholic or other private. However because of the small percentages of Catholic and other private schools, and minimal differences in how they compared to public schools, they were combined to form "other". Sponsor was dummy coded Public: 1, Other: 0.

The Level-2 variables are treated as contextual variables that may be beyond students' direct control. Although students play a role in them (triadic reciprocal determinism theory), they are more directly controlled by school administrators and the community. Levine (1991) defined school climate as the physical and mental atmosphere of the school as perceived by teachers, students and parents. However for this study, the variable is used as the perception of the school principal only.

The Level-1 (student) motivational variables are utilized as predictors of mathematics self-efficacy and achievement while also controlling for the inherent student characteristics (race and gender). Table 3.3 below presents a summary of the names, number of items and the corresponding coefficient of reliability for each scale.

Table 3.3: Confirmatory principal factor analysis of the motivational factors and school climate and their Cronbatch Alpha reliability coefficients

<i>Scale</i>	<i>Number of Items</i>	<i>Alpha</i>
10 <sup>th</sup> Grade mathematics self-efficacy	5	.93
12 <sup>th</sup> Grade mathematics self-efficacy	5	.91
Extrinsic motivation scale	3	.85
General effort and persistence scale	5	.89
Individual-Determination	4	.84
Class preparedness scale	3	.81
Academic climate scale	5	.86

### 3.5 Analysis of data

Data was analyzed using the SPSS statistical software (PASW Statistics 18). Various analyses were geared towards answering specific research questions. Research Question 1 was analyzed by the results of a standard multiple linear regression. The standardized and un-standardized estimates of the partial regression coefficients of the motivational scales represent the strength of the relationship with mathematics self-efficacy and mathematics achievement.

For research Questions 2, 3, and 4, the extents to which sponsor, location, school climate and socioeconomic status predicted the schools' adjusted averages, mediated the strengths of the relationships of motivational factors, and moderated the gender and race gaps respectively, for both mathematics achievement and mathematics self-efficacy, a two-level hierarchical linear

model (HLM) was considered best suited for the data analysis (Raudenbush & Bryk, 2002).

Mathematics self-efficacy and mathematics achievement were considered outcome variables of the student level- model. HLM is recommended in the analysis of data with measurements in groups. Mathematics achievement and mathematics self-efficacy were student variables that were predicted by motivational factors, gender and race at Level-1, in different groups (schools) that were different by climate, socioeconomic status, sponsor and location at Level-2.

### 3.51 Model specifications

#### *Student-Level Models*

$$MATH_{ij} = \beta_{0j} + \beta_{1j}(IND_{ij}) + \beta_{2j}(XMTV_{ij}) + \beta_{3j}(EFPER_{ij}) + \beta_{4j}(PREP_{ij}) + \beta_{5j}(SEX_{ij}) + \beta_{6j}(BLACK_{ij}) + \beta_{7j}(HISPANIC_{ij}) + \beta_{8j}(EFFICACY_{ij}) + \varepsilon_{ij} \quad (1)$$

$$EFFICACY_{ij} = \beta_{0j} + \beta_{1j}(IND_{ij}) + \beta_{2j}(XMTV_{ij}) + \beta_{3j}(EFPER_{ij}) + \beta_{4j}(PREP_{ij}) + \beta_{5j}(SEX_{ij}) + \beta_{6j}(BLACK_{ij}) + \beta_{7j}(HISPANIC_{ij}) + \beta_{8j}(MATH_{ij}) + \varepsilon_{ij} \quad (2)$$

Where equation (1) models mathematics achievement and equation (2) models mathematics self-efficacy of a student  $i$  in school  $j$ , the y-intercept  $\beta_{0j}$  represents the adjusted school averages of mathematics achievement and mathematics self-efficacy in equations (1) and (2) respectively, for school  $j$ . The coefficients  $\beta_{1j}$ ,  $\beta_{2j}$ ,  $\beta_{3j}$  and  $\beta_{4j}$  represents the strengths of the relationships between each of the four motivational variables and mathematics achievement in equation (1), and mathematics self-efficacy in equation (2). The coefficient  $\beta_{8j}$  in equation (1) represents the strength of the relationship between mathematics self-efficacy as and mathematics achievement, and in equation (2) represents the strength of mathematics achievement as a predictor of mathematics self-efficacy.  $\beta_{5j}$  represents the gender gap in mathematics

achievement and mathematics self-efficacy in equations (1) and (2) respectively, while  $\beta_{6j}$  and  $\beta_{7j}$  represent the Black and Hispanic students' achievement gaps respectively.  $\varepsilon_{ij}$  are the error terms assumed to be normally distributed with a mean of 0 and variance  $\sigma_\varepsilon^2$ , assumed to be constant across schools.

#### *School- Level model*

The parameter estimates from student-level models in equation (1) and (2) were then treated as outcomes at the school level with the school variables, location (urban, suburban or rural), climate, aggregate socioeconomic status, and school sponsor (public or private) as predictor variables in model equation (3)

$$\beta_{qj} = \gamma_{qj} + \gamma_q(LOCATION)_j + \gamma_q(CLIMATE)_j + \gamma_q(SES)_j + \gamma_q(SPONSOR) + U_{qj} \quad (3)$$

for  $j=1,2,3,4,\dots,J$  number of schools and  $q=1,2,3,4,5,6,7,8$  number of parameters in student-level model. The model equation (3) is specified for both mathematics achievement and mathematics self-efficacy. The vectors  $\gamma_{qj}$  were coefficients associated with the strengths of mediation of socioeconomic status and school climate, and the location and sponsor differences in moderating the parameters at the student level model.  $U_{qj}$  is a random error associated with each  $\beta_{qj}$  for  $j$  schools in the study. They were assumed to be normally distributed with mean zero and some variance-covariance structure.

## CHAPTER 4

### RESULTS

#### 4.1 Introduction

In chapter 3, the research methodology of the study was discussed. Sources of data, the sample, variables and the data analysis to answer the research questions were explained. In this chapter, the results from various analyses of the data, according to the five questions, are presented. The results are presented in the order of the research questions.

#### 4.2 Research Question 1:

*To what extent do students' motivational factors such as extrinsic motivation, effort and persistence, individual determination, and learner preparedness, and personal characteristics, such as gender and race, predicts their mathematics self-efficacy and achievement?*

Two multiple linear regression models were used for the prediction of mathematics achievement and mathematics self-efficacy respectively. The first model used motivational factors: extrinsic motivation, effort and persistence, individual determination, and learner preparedness together with students' gender, race and mathematics self-efficacy as predictors of mathematics achievement. In the second model, achievement was then used together with the same motivational factors, gender and race in predicting mathematics self-efficacy.



#### 4.21 Mathematics achievement

The standardized and unstandardized coefficients of the predictors of mathematics achievement, their partial correlation coefficients, and their significance are presented in table 4.1. The results indicate that all of the motivational factors and the demographic characteristics were significant predictors of mathematics achievement. The negative coefficients for extrinsic motivation ( $\beta = -.486$ ,  $p < .05$ ) and effort and persistence ( $\beta = -1.157$ ,  $p < .05$ ) indicated a negative relationship of these variables with mathematics achievement. The gender coefficient ( $\beta = 2.202$ ,  $p < .05$ ) indicated that male students were predicted to achieve about 2.2 points higher than their female counterparts. Hispanic ( $\beta = 9.12$ ,  $p < .05$ ) and Black ( $\beta = 12.44$ ,  $p < .05$ ) coefficients showed that Hispanic and Black students were predicted to have about 9 and 12 points scores lower respectively, than the other racial groups combined, in mathematics achievement. The overall model accounted for approximately 34% of the variance in mathematics achievement. Figures 4.1, 4.2 and 4.3 illustrate some of the relationships between mathematics and some motivational factors by race and gender.

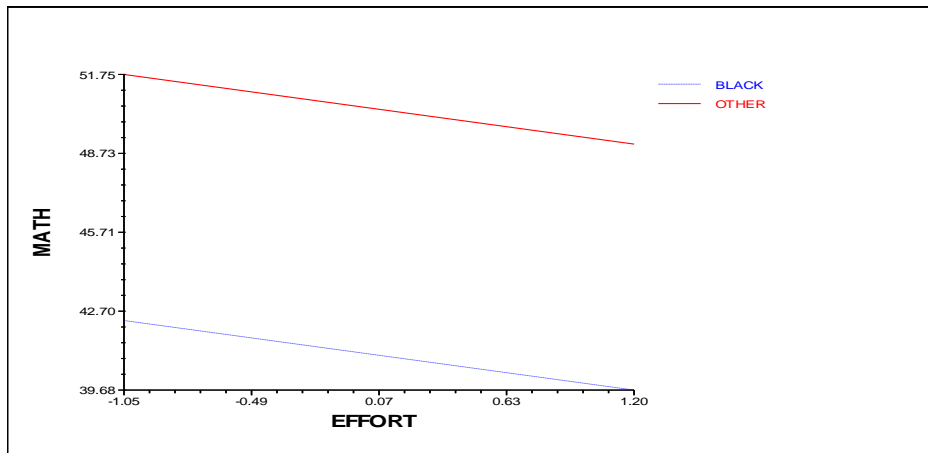


Figure 4.1. The relationship between effort and persistence and mathematics achievement by race

Table 4.1

Multiple regression results for the prediction of mathematics achievement by student motivational factors, gender and race.

	<u>Unstandardized Coefficients</u>		<u>Standardized coefficients</u>		<u>Correlations</u>		
	$\beta$	Standard error	Beta	p	Zero-order	Partial	Part
(Constant)	30.632	.045		.000			
Individual Determination	4.617	.016	.311	.000	.348	.246	.206
Extrinsic Motivation	-.486	.015	-.033	.000	.148	-.028	-.023
Effort and Persistence	-1.157	.018	-.078	.000	.202	-.056	-.045
Learner preparedness	1.381	.011	.088	.000	.148	.104	.085
Math self-efficacy's	4.319	.011	.302	.000	.407	.326	.280
Gender (Male=1, Female=0)	2.202	.021	.075	.000	.127	.090	.073
Black (Black=0, Others =1)	12.440	.033	.263	.000	.244	.303	.259
Hispanic (Hispanic=0, others=1)	9.129	.031	.209	.000	.207	.246	.206

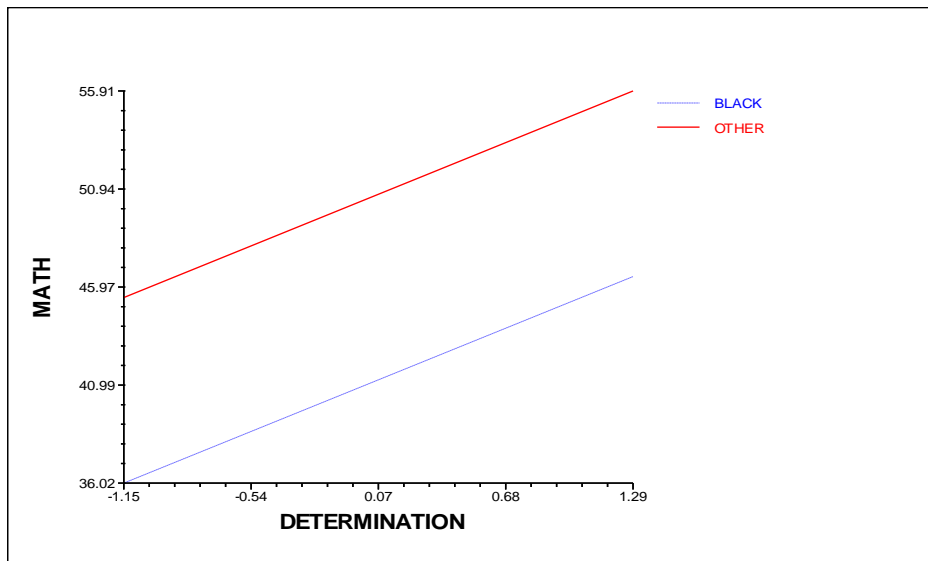


Figure 4.2 Relationship between mathematics achievement and individual determination by race

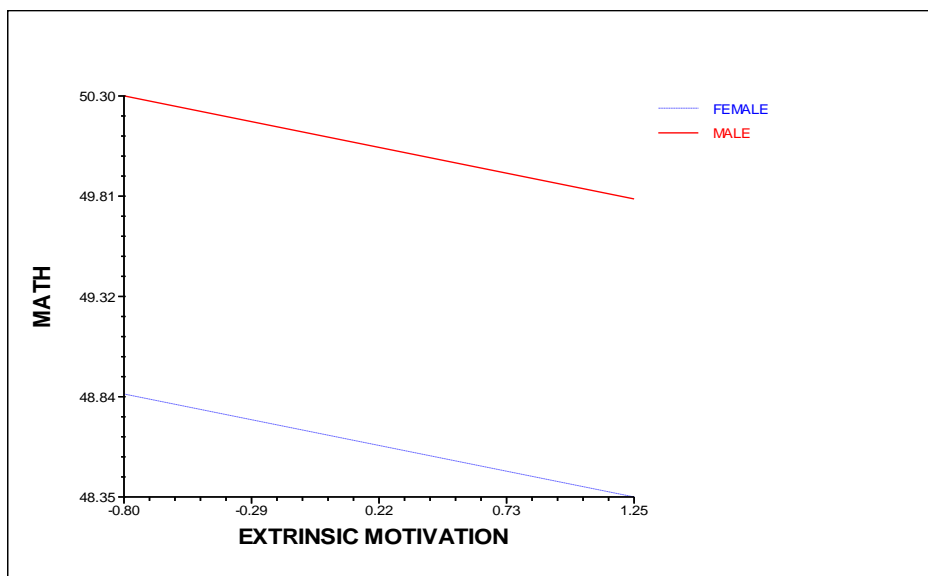


Figure 4.3 Relationship between extrinsic motivation and mathematics achievement by gender

Figures 4.1 and 4.3 indicated that mathematics achievement relates negatively with both effort and persistence, and extrinsic motivation, while Figure 4.2 showed a positive relationship between achievement and individual determination. The gender and race gaps were consistent across all the levels of the motivational factors.

#### 4.22 Mathematics Self-efficacy

A Multiple linear regression model was used to determine the extent to which mathematics self-efficacy can be predicted by the motivational variables (individual determination, effort and persistence, learner preparedness and extrinsic motivation), mathematics achievement, gender, and Black and Hispanic student's achievement gap indicators. The results are presented on Table 4.2 on the next page. All of the variables in the model were found to be significant predictors of mathematics self-efficacy. Extrinsic motivation and learner preparedness had negative relationships with mathematics self-efficacy, while effort and persistence, mathematic achievement and individual determination had positive relationships. The negative Black and Hispanic coefficients ( $\beta = -.220$ ,  $p < .05$ , and  $\beta = -.124$ ,  $p < .05$  respectively) show that both Hispanic and Black students are predicted to have lower mathematics self-efficacy compared to other students. The un-standardized coefficient for gender ( $\beta = .190$ ,  $p < .05$ ) imply that male students are predicted to score 0.2 standard deviations higher than females in mathematics self-efficacy. The overall model accounted for almost 23% of the variance in mathematics self-efficacy.

Table 4.2

Multiple regression results for the prediction of mathematics self-efficacy by student motivational factors, gender, and race and mathematics achievement.

	$\beta$	<i>Standard error</i>	<i>Beta</i>	<i>p</i>	<i>Part</i>	<i>Partial</i>
(Constant)	-1.052	.004		.000		
Individual determination	.143	.001	.138	.000	.101	.089
Extrinsic motivation	-.030	.001	-.029	.000	-.023	-.020
Effort and Persistence	.135	.001	.131	.000	.086	.076
Learner preparedness	-.021	.001	-.019	.000	-.021	-.019
Gender (Male =1, Female=0)	.190	.002	.093	.000	.102	.090
BLACK (Black =0, Others =1)	-.220	.003	-.067	.000	-.071	-.063
HISPANIC (Hispanic =0. Others 1)	-.124	.002	-.041	.000	-.044	-.039
Math achievement	.025	.000	.353	.000	.326	.303

### 4.3 Hierarchical Linear Model Analysis

A two level hierarchical linear model (Raudenbush & Bryk, 2002) was used to determine the extents to which school contextual variables can predict students' mathematics achievement and self-efficacy, when their motivational factors and individual characteristics are controlled for. The HLM version 6.08 statistical software was used for analysis of data. According to Raudenbush and Bryk (2002), HLM is recommended for analysis of nested data. In this study students' motivational factors, gender, race, mathematics self-efficacy and mathematics achievement were level-1 (students) variables, while school climate, sponsor, location and socioeconomic status were level-2 predictors. Level-1 variables were used as predictors of mathematics achievement and mathematics self-efficacy. Climate and socioeconomic status were continuous variables with mean 0 and standard deviation 1. Sponsor was a categorical variable dummy coded Public: 1, Other: 0. Location was also a categorical variable with three groups (urban, sub-urban and rural). Findings for Questions 2, 3, and 4 are based on a two-level HLM analysis and are presented in the remaining part of this chapter.

### 4.4 Research question 2

*To what extent do school variables such as sponsor, location, socioeconomic status and climate predict a school's adjusted average in mathematics achievement and mathematics self-efficacy?*

In this question the y-intercepts ( $\beta_0$ ) for mathematics achievement and mathematics self-efficacy were considered outcomes in the level-2. The y-intercept represents the adjusted school average for mathematics achievement and mathematics self-efficacy. Results for the prediction of the school adjusted averages in students' achievement and efficacy are presented in Tables 4.3 and 4.4 respectively.

Table 4.3 HLM results of the extent to which location, school climate, socioeconomic status, and sponsor predicted school adjusted average in mathematics achievement

	<u>Location</u>		<u>Climate</u>		<u>Socioeconomic status</u>		<u>Sponsor</u>	
	<i>γ</i>	<i>p</i>	<i>γ</i>	<i>p</i>	<i>γ</i>	<i>p</i>	<i>γ</i>	<i>p</i>
Urban=1 vs. Suburban=0	-.780	.085	1.82	.244	14.72	.000*	.178	.766
Urban=1 vs. Rural=0	-1.61	.005*	3.15	.115	14.82	.000*	0.139	.873
Suburban=1 vs. Rural=0	-.651	.132	.019	.990	13.83	.000*	-.147	.831

#### 4.41 Mathematics achievement

Table 4.3 presents the HLM results of the extent to which location, school climate, socioeconomic status, and sponsor predicted the school adjusted average in mathematics achievement. The results reveal that location was statistically significant ( $\gamma = -1.61, p < .05$ ) only in the urban versus rural case. In other words urban schools' adjusted school averages were predicted to be lower than both rural and suburban schools, but the difference is significant only when compared with rural schools. School socioeconomic status had a statistically significant positive relationship with adjusted school averages in mathematics achievement in all the location contexts: urban versus suburban ( $\gamma = 14.72, p < .01$ ), urban versus rural ( $\gamma = 14.82, p < .01$ ) and suburban versus rural ( $\gamma = 13.83, p < .01$ ). One standard deviation of socioeconomic status could yield approximately 14 points in adjusted school averages in mathematics. School climate and sponsor were not statistically significant in predicting a school's adjusted average in mathematics achievement.

#### 4.42 Mathematics self-efficacy

Table 4.4 presents HLM results on the extent to which location, school climate, socioeconomic status and sponsor predicted school adjusted average in mathematics self-efficacy. The results reveal that socioeconomic status was significant in predicting a school's adjusted average in mathematics self-efficacy regardless of location. Urban schools were predicted to be higher than suburban schools ( $\gamma = .178, p < .05$ ), higher than rural schools ( $\gamma = .165, p < .05$ ), while suburban schools were found to be higher than rural schools ( $\gamma = .184, p < .05$ ). School climate, sponsor and location were not statistically significant predictors of adjusted school average in mathematics self-efficacy.



Table 4.4 HLM results of the extent to which location, school climate, socioeconomic status and sponsor predicted school adjusted average in mathematics self-efficacy

	<u>Location</u>		<u>Climate</u>		<u>Socioeconomic status</u>		<u>Sponsor</u>	
	$\gamma$	$p$	$\gamma$	$p$	$\gamma$	$p$	$\gamma$	$p$
Urban=1 vs. Sub=0	-.006	.771	.023	.741	.178	.000*	-.022	.457
Urban=1 vs. Rural=0	.009	.725	.036	.671	.165	.000*	-.017	.626
Sub=1 vs. Rural=0	.008	.755	-.012	.890	.184	.000*	-.051	.228

#### 4.5 Research question 3

*To what extent do schools' sponsor, location, socioeconomic status and climate mediate the relationship between extrinsic motivation, effort and persistence, individual determination, and learner preparedness, and mathematics self-efficacy and achievement?*

##### 4.51 Mathematics achievement

Tables 4.5a, 4.5b and 4.5c present the HLM results for mathematics achievement in urban vs. suburban, urban vs. rural and suburban vs. rural respectfully. In the case of urban vs. suburban (Table 4.5a), location was a significant mediator in the relationship between extrinsic motivation and mathematics achievement ( $\gamma = -1.06$ ,  $p < .05$ ), while sponsor was significant for learner preparedness and mathematics achievement ( $\gamma = .965$ ,  $p < .05$ ). In other words, students' mathematics achievement in suburban schools was predicted to be less dependent on changes in extrinsic motivation than those in urban schools. Also, learner preparedness was predicted to be a stronger predictor of achievement in public schools than non-public school. Figures 4.4 and 4.5 represent the significant relationships graphically.

Figure 4.4 show a significant weaker positive relationship between extrinsic motivation and mathematics achievement for suburban schools, and stronger negative relationship for urban schools. Figure 4.5 shows positive relationships between achievement and learner preparedness for both public and other schools, but the relationship was predicted to be stronger in public schools.

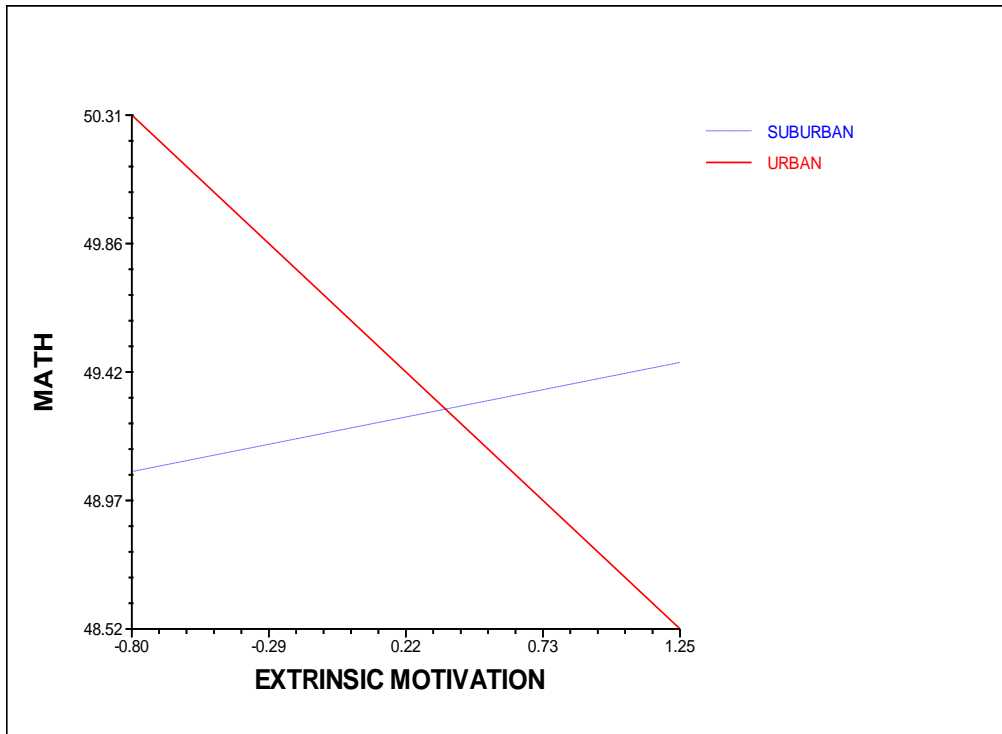


Figure 4.4 Relationship between mathematics achievement and extrinsic motivation by location

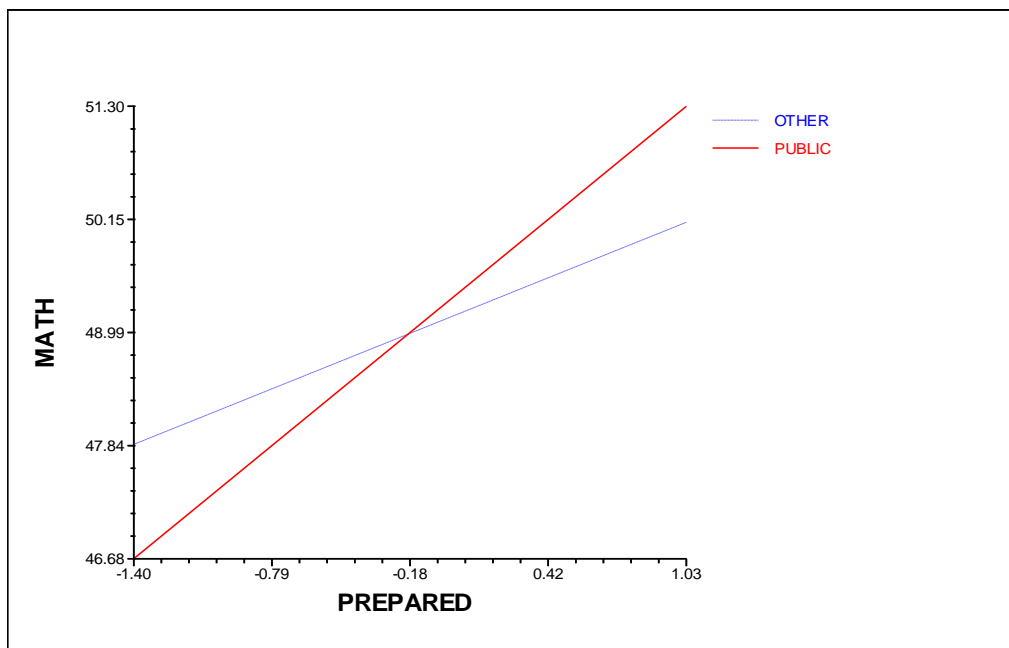


Figure 4.5 Relationship between learner preparedness and mathematics achievement by school sponsor in urban versus suburban location

Table 4.5a

HLM results for the extents to which location (Urban = 1, versus Suburban =0), climate, socioeconomic status and sponsor mediate the relationship between motivational factors, gender and race with mathematics achievement

<i>Factor</i>	<i>Location</i>		<i>Climate</i>		<i>Socioeconomic Status</i>		<i>Sponsor**</i>	
	<i>γ</i>	<i>p</i>	<i>γ</i>	<i>p</i>	<i>γ</i>	<i>p</i>	<i>γ</i>	<i>p</i>
Individual determination	-.164	.710	-2.07	.186	.985	.114	.928	.108
Extrinsic Motivation	-1.06	.017*	1.05	.747	-.592	.283	-.186	.726
Effort and persistence	.055	.911	.971	.594	.333	.595	.169	.786
Learner preparedness	-.154	.575	.871	.353	.072	.851	.965	.018*
Gender	.870	.081	.080	.963	.568	.392	.285	.782
Math efficacy	.064	.842	.285	.782	-.263	.495	-.102	.794
Black	-.316	.716	-6.620	.080	.570	.638	1.461	.244
Hispanic	-.179	.825	.684	.812	.847	.512	3.141	.010*

\*\*Sponsor (Public =1, Other =0); \*p < .05)

The results in Table 4.5a above reveal that the relationship between learner preparedness and mathematics achievement is stronger in public schools than in non-public schools. The Hispanic versus non-Hispanic achievement gap is wider in public schools than it is in other schools. The strength of the relationship between extrinsic motivation and mathematics achievement is significantly weaker in urban schools than in suburban schools.

In the case of urban versus rural schools in Table 4.5b below, the results reveal that individual determination is significantly strengthened by higher socioeconomic status in predicting mathematics achievement ( $\gamma = 1.572$ ,  $p < .05$ ). In other words, the strength of individual determination as a predictor of mathematics achievement is more in higher socioeconomic status schools. There are no other significant relationships.

In the case of suburban versus rural schools in Table 4.5c, the sponsor is significant in mediating the role of learner preparedness in predicting mathematics achievement ( $\gamma = 1.59$ ,  $p < .05$ ). This implies that the variance of mathematics achievement attributed to one standard deviation of learner preparedness was predicted to be greater in public schools than it was in non-public schools.

Figure 4.6 reveals a stronger positive relationship between learner preparedness and mathematics achievement in public schools than in other schools. Figure 4.7 shows a significant positive relationship between school climate and mathematics achievement for Black students, but no significant relationship for the other students in the case of suburban and rural schools comparison.

Table 4.5b

HLM results for the extents to which location, climate, socioeconomic status and sponsor mediate the relationship between motivational factors, gender and race with mathematics achievement (Urban =1 verses Rural =0)

<u>Factor</u>	<u>Location</u>		<u>Climate</u>		<u>Socioeconomic Status</u>		<u>Sponsor**</u>	
	$\gamma$	$p$	$\gamma$	$p$	$\gamma$	$p$	$\gamma$	$p$
Individual determination	-.127	.830	-.0142	.949	1.572	.049*	1.43	.076
Extrinsic Motivation	-.964	.086	1.71	.339	-.938	.242	-.750	.340
Effort and persistence	.147	.816	-1.39	.562	.031	.971	.122	.893
Learner preparedness	-.101	.793	-.522	.670	-.187	.731	.164	.774
Gender	.567	.410	.193	.924	.914	.264	.630	.497
Math efficacy	-.064	.842	.284	.782	-.263	.495	-.102	.794
Black	-1.002	.372	-3.776	.441	1.041	.482	1.380	.399
Hispanic	.608	.587	-3.830	.304	.520	.731	2.754	.078

\*\*Sponsor (Public =1, Other =0); \*p < .05

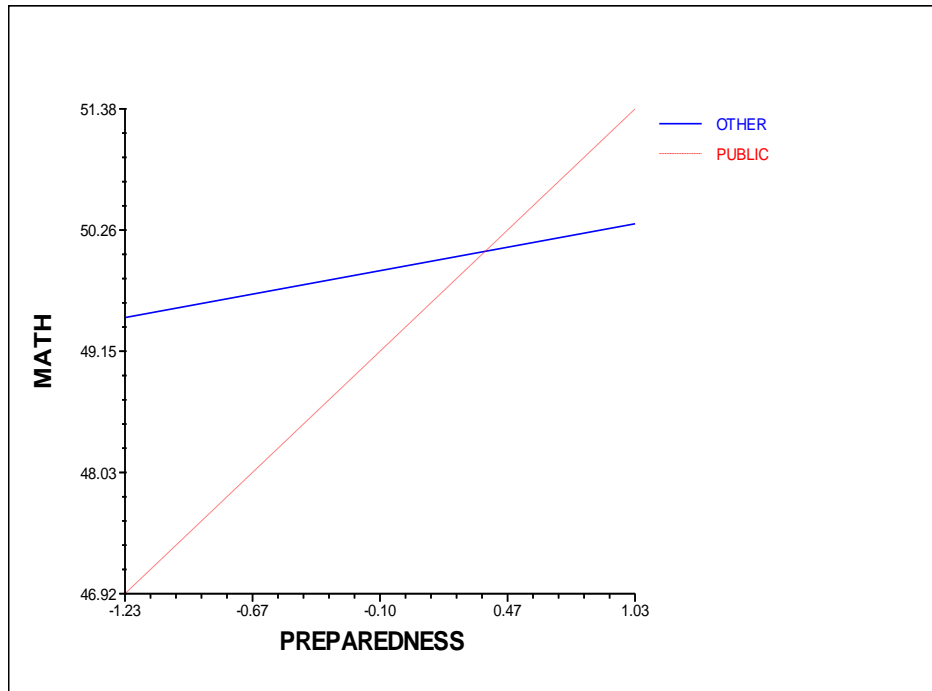


Figure 4.6 Relationship between learner preparedness and mathematics achievement according to sponsor in urban versus rural location

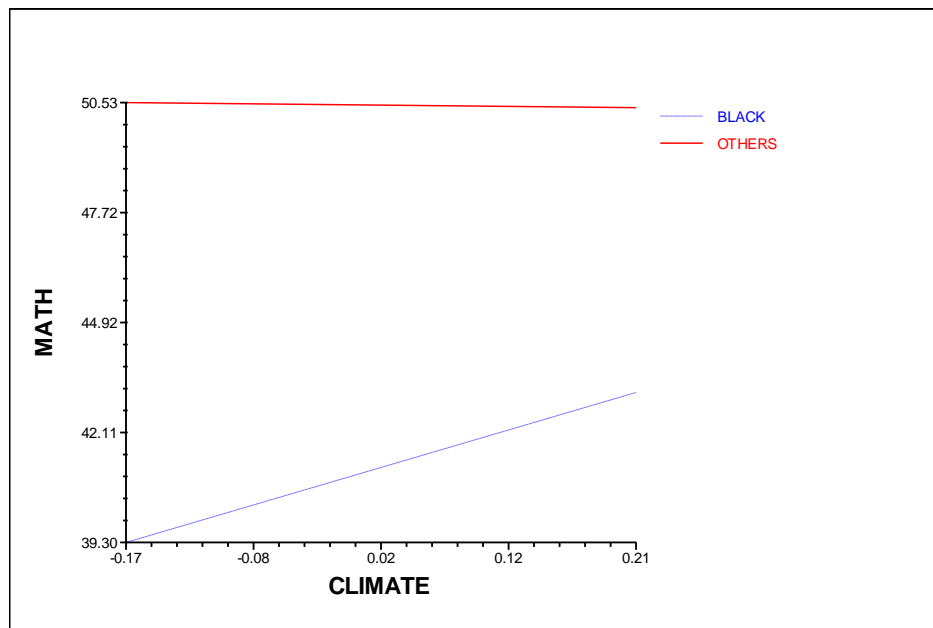


Figure 4.7 Relationship between mathematics achievement and school climate by race (Black students compared to others) in urban versus rural locations

Table 4.5c

HLM results for the extents to which location, climate, socioeconomic status and sponsor mediate the relationship between motivational factors, gender and race with mathematics achievement (Suburban verses Rural)

<i>Factor</i>	<i>Location</i>		<i>Climate</i>		<i>Socioeconomic Status</i>		<i>Sponsor**</i>	
	<i>γ</i>	<i>p</i>	<i>γ</i>	<i>p</i>	<i>γ</i>	<i>p</i>	<i>γ</i>	<i>p</i>
Individual determination	.160	.762	-3.23	.056	1.08	.150	1.30	.059
Extrinsic Motivation	.124	.792	.030	.985	.196	.734	.262	.664
Effort and persistence	.034	.954	.050	.980	.151	.828	-.628	.373
Learner preparedness	.398	.249	.770	.487	-.262	.553	1.59	.002*
Gender	-.360	.584	.325	.883	-.506	.530	-1.162	.194
Math efficacy	-.406	.265	.351	.785	-.082	.857	.287	.574
Black	-.348	.730	-10.24	.006*	.606	.668	3.694	.033*
Hispanic	1.267	.214	1.155	.214	1.491	.321	3.778	.014

\*\*Sponsor (Public =1, Other =0); \*p < .05)



#### 4.52 Mathematics self-efficacy

Tables 4.6a, 4.6b and 4.6c present the HLM results for the extents to which school factors such as sponsor, location, socioeconomic status and climate— mediate the relationship between motivational factors and mathematics self-efficacy. The results in Table 4.6a reveal that the strength of mathematics achievement as a predictors of mathematics self-efficacy is lower in public schools than in other schools ( $\gamma = -.008$ ,  $p < .05$ ), and is strengthened with a rise in socioeconomic status ( $\gamma = .005$ ,  $p < .05$ ).

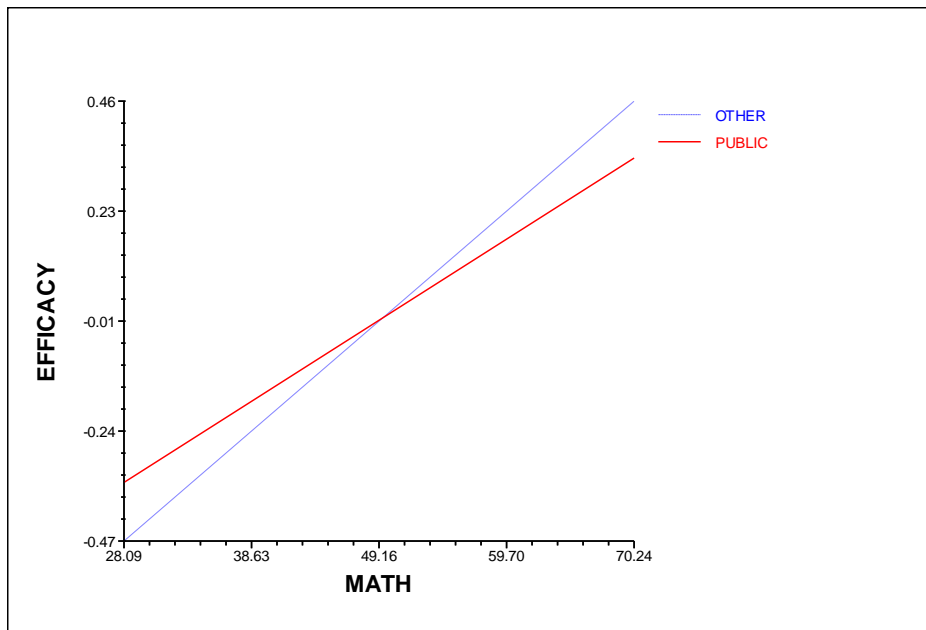


Figure 4.8 Relationship between mathematics achievement and mathematics self-efficacy according to sponsor

Table 4.6a

HLM results for the extents to which location, climate, socioeconomic status and sponsor mediate the relationship between motivational factors, gender and race with mathematics self-efficacy (Urban=1 versus Suburban=0)

<u>Factor</u>	<u>Location</u>		<u>Climate</u>		<u>Socioeconomic Status</u>		<u>Sponsor**</u>	
	$\gamma$	$p$	$\gamma$	$p$	$\gamma$	$p$	$\gamma$	$p$
Individual determination	-.022	.463	.091	.354	.054	.179	-.021	.592
Extrinsic Motivation	-.001	.958	-.059	.542	.011	.747	.010	.784
Effort and persistence	-.015	.645	.091	.426	-.059	.184	-.057	.198
Learner preparedness	.008	.638	-.003	.960	.019	.551	-.030	.219
Gender	-.114	.001*	-.003	.981	-.006	.893	.109	.015*
Math Achievement	-.003	.076	-.004	.406	.005	.029*	-.008	.003*
Black	.002	.972	-.153	.378	.056	.402	-.025	.712
Hispanic	-.052	.243	-.084	.535	.021	.725	.029	.697

\*\*Sponsor (Public =1, Other =0); \*p < .05

Table 4.6b results show that the relationship between mathematics self-efficacy and mathematics achievement is stronger in schools with higher average socioeconomic status ( $\gamma = .055$ ,  $P < .05$ ). The strength of individual determination in predicting mathematics self-efficacy is significantly lower in urban than in rural schools ( $\gamma = -.094$ ,  $p < .05$ ), while extrinsic motivation is stronger in predicting mathematics self-efficacy in urban than rural schools ( $\gamma = .077$ ,  $p < .05$ ).

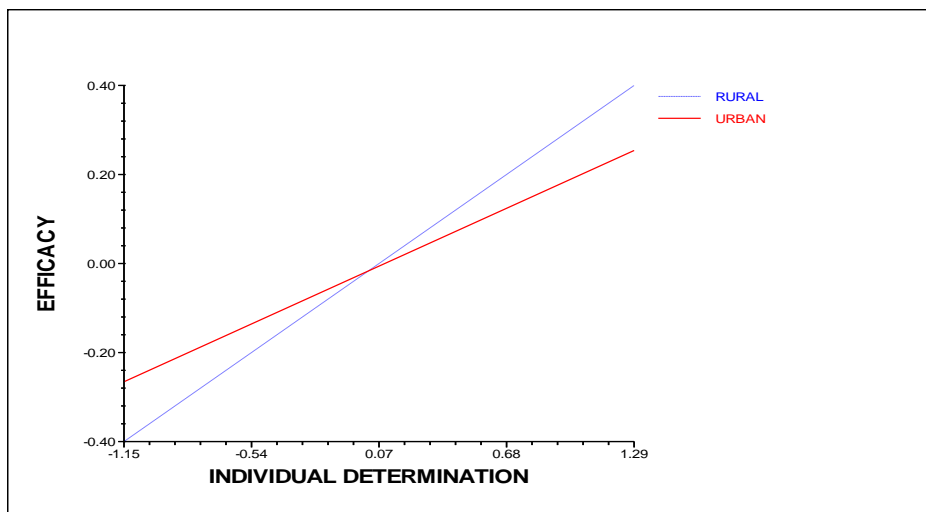


Figure 4.9 Relationship between individual determination and mathematics self-efficacy according to location (urban versus rural)

The results in Figure 4.9 above show that individual determination has a significant positive relationship to mathematics self-efficacy for both rural and urban, with the rural schools predicted to have a stronger relationship than urban schools. The results in Figure 4.10 below reveal a strong negative relationship between self-efficacy and extrinsic motivation in rural schools, and a comparatively weaker positive relationship in urban schools.

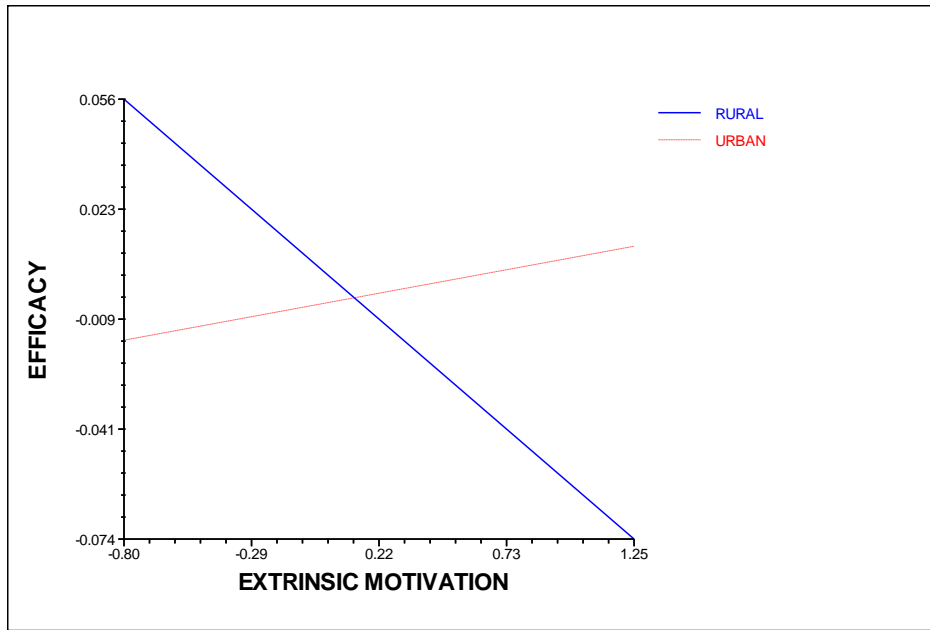


Figure 4.10 Relationship between extrinsic motivation and mathematics self-efficacy according to location

Table 4.6b

HLM results for the extents to which location, climate, socioeconomic status and sponsor mediate the relationship between motivational factors, gender and race with mathematics self-efficacy (Urban =1 verses Rural=0)

<u>Factor</u>	<u>Location</u>		<u>Climate</u>		<u>Socioeconomic Status</u>		<u>Sponsor**</u>	
	$\gamma$	$p$	$\gamma$	$p$	$\gamma$	$p$	$\gamma$	$p$
Individual determination	-.094	.034*	-.012	.933	-.015	.783	-.006	.915
Extrinsic Motivation	.077	.037*	-.179	.177	.083	.112	.032	.544
Effort and persistence	.013	.784	.020	.226	-.0386	.541	-.057	.415
Learner preparedness	-.041	.072	.014	.843	-.028	.306	-.052	.108
Gender	-.09	.021*	.055	.669	-.063	.234	-.121	.028*
Math Achievement	-.003	.076	-.004	.406	.055	.029*	-.028	.053
Black	.149	.034*	-.046	.836	.033	.664	.134	.138
Hispanic	.042	.513	.008	.966	.043	.611	.149	.128

\*\*Sponsor (Public =1, Other =0); \*p < .05

Table 4.6c results indicate that mathematics achievement is weaker in predicting mathematics self-efficacy in public schools than other schools ( $\gamma = -.005$ ,  $p < .05$ ). Learner preparedness is a stronger predictor of mathematics self-efficacy in rural schools than suburban ( $\gamma = -.041$ ,  $p < .05$ ), while extrinsic motivation relate to mathematics self-efficacy more strongly in suburban schools than in urban schools.

Table 4.6c

HLM results for the extents to which location, climate, socioeconomic status and sponsor mediate the relationship between motivational factors, gender and race with mathematics self-efficacy (Suburban=1 verses Rural=0)

<i>Factor</i>	<i>Location</i>		<i>Climate</i>		<i>Socioeconomic Status</i>		<i>Sponsor**</i>	
	<i><math>\gamma</math></i>	<i>p</i>	<i><math>\gamma</math></i>	<i>p</i>	<i><math>\gamma</math></i>	<i>p</i>	<i><math>\gamma</math></i>	<i>p</i>
Individual determination	-.073	.065	-.096	.435	.013	.787	-.028	.614
Extrinsic Motivation	.081	.016*	-.055	.584	-.024	.526	-.013	.742
Effort and persistence	.032	.447	.150	.242	-.040	.446	-.021	.718
Learner preparedness	-.041	.045*	-.052	.431	.023	.365	-.016	.595
Gender	.036	.328	.110	.410	-.013	.791	-.022	.702
Math Achievement	-.002	.112	.0005	.922	.002	.443	-.005	.042*
Black	.114	.095	-.031	.890	.97	.270	-.109	.303
Hispanic	.052	.384	-.068	.707	.080	.307	.041	.703

\*\*Sponsor (Public =1, Other =0); \*p < .05

#### 4.6 Research Question 4

*To what extent do schools' sponsor, location, socioeconomic status and climate moderate the gender and race gap in mathematics self-efficacy and achievement?*

The results for mathematics achievement gaps are presented on Tables 4.5a, 4.5b and 4.5c. Tables 4.6a, 4.6b and 4.6c present results for gender and racial gaps in mathematics self-efficacy.

##### 4.6.1 Mathematics achievement

In Table 4.5a, school sponsor significantly moderates the Hispanic gap in mathematics achievement ( $\gamma = 3.141$ ,  $p < .05$ ). This indicates that the gap between Hispanic students and the rest of their counterparts in public schools was predicted to be more than 3 points higher than in other schools in mathematics achievement. Table 4.5c the results reveal that, the gap between Black students and the rest of the students in mathematics achievement is significantly reduced by a perceived better school climate ( $\gamma = -10.24$ ,  $p < .05$ ), and the gap was significantly higher in public schools than other schools ( $\gamma = 3.69$ ,  $p < .05$ ).

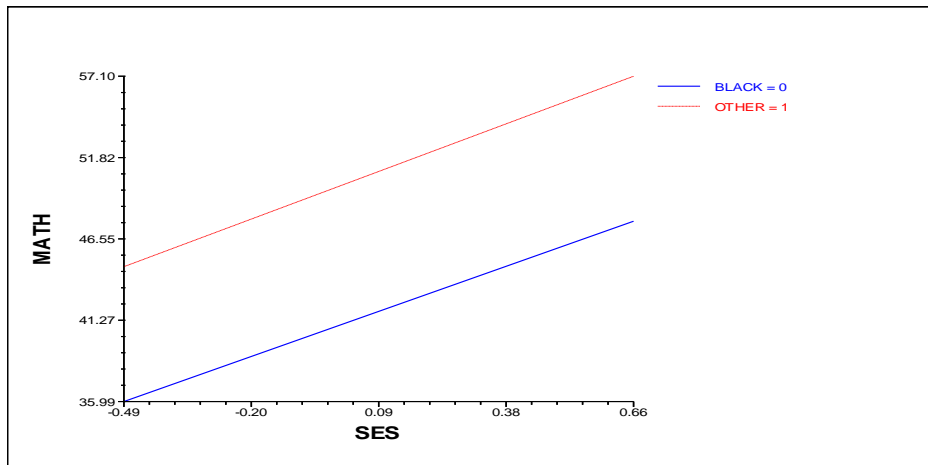


Figure 4.11 Relationship between mathematics achievement and socioeconomic status by race (Black students compared to others)



Figure 4.11 shows that higher socioeconomic status leads to higher achievement consistently maintaining the achievement gap between the Black students and others.

Similar trends are observed for gender and the Hispanic students' achievement gaps.

#### 4.62 Mathematics self-efficacy

Table 4.6a results predicted gender gap to be lower in urban schools than suburban ( $\gamma = -.114, p < .05$ ), but higher in public schools than other schools ( $\gamma = .109, p < .05$ ) in mathematics self-efficacy. Table 4.6b reveals a significantly lower gender gap in urban schools than rural ( $\gamma = -.09, P < .05$ ), and lower in public schools than other schools ( $\gamma = -.121, p < .05$ ) in mathematics self-efficacy. Black students' mathematics self-efficacy gap is higher in urban school compared to rural schools ( $\gamma = .149, p < .05$ ).

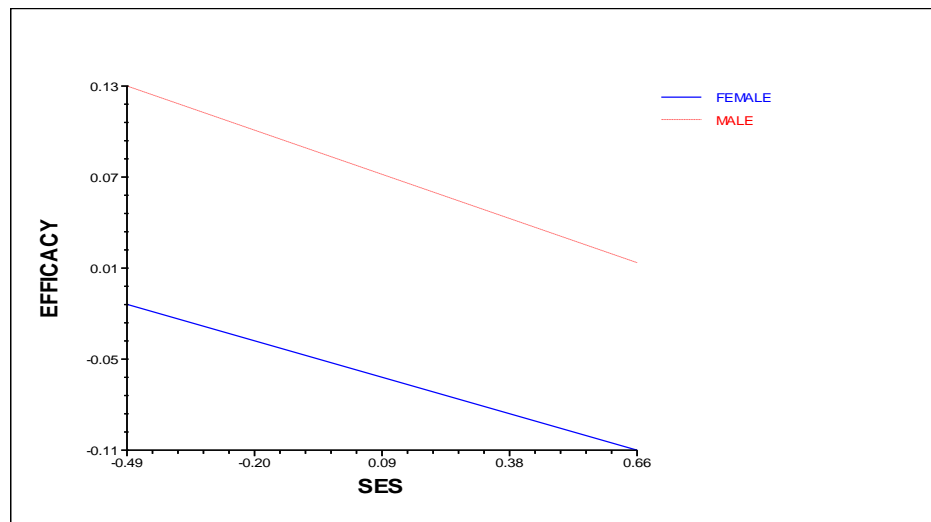


Figure 4.12 Relationship between mathematics self-efficacy and socioeconomic status by gender

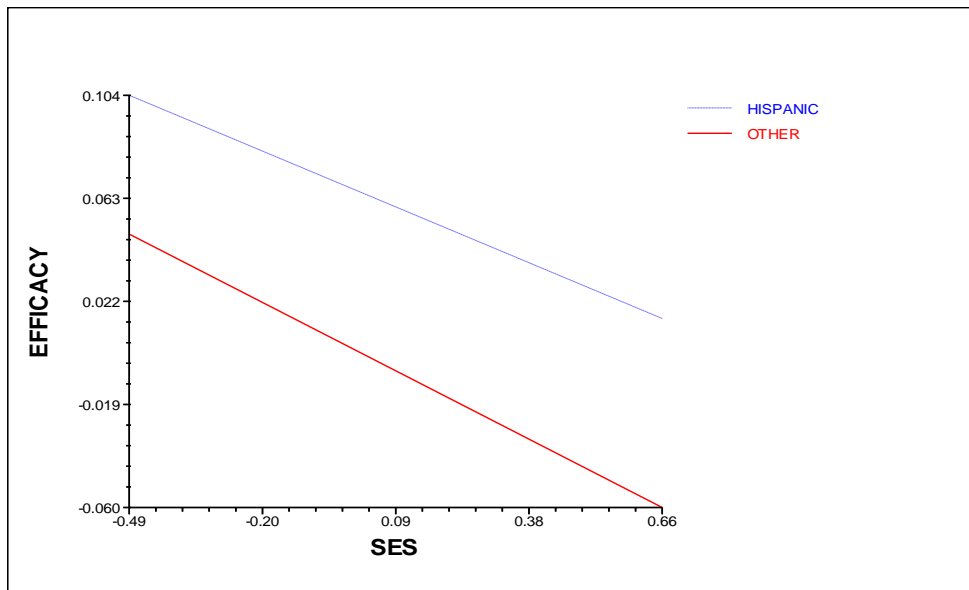


Figure 4.13 Relationship between mathematics self-efficacy and socioeconomic status by race (Hispanic students compared to others)

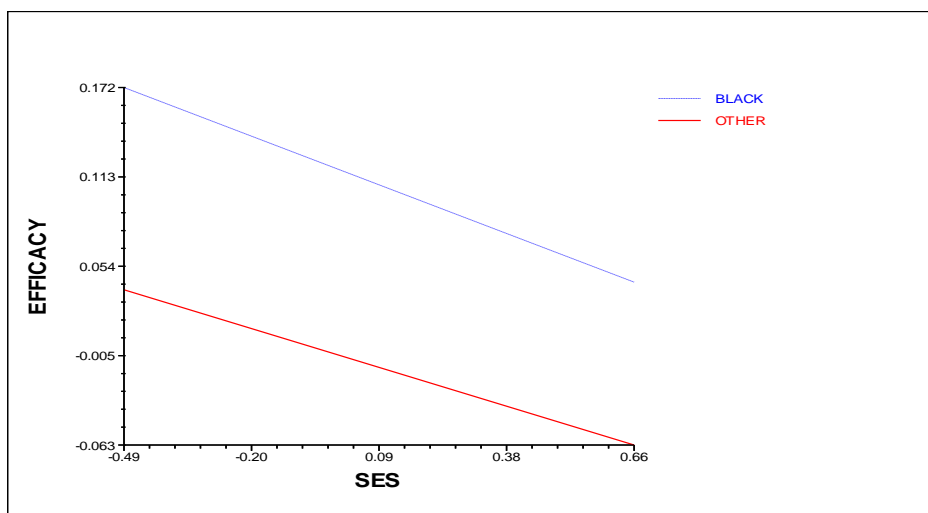


Figure 4.14 Relationship between mathematics self-efficacy and socioeconomic status by gender.

The results in Figure 4.12 indicate that male students have a higher mathematics self-efficacy than female students, self-efficacy drops with increase in socioeconomic status, and the gap between male and female narrows at higher socioeconomic status. Similar trends are seen in Figure 4.13 and 4.14

#### 4.7 Conclusion

Mathematics achievement and mathematics self-efficacy were predicted by motivational factors, gender and race. A two level hierarchical linear model was used to determine the extent school contexts: climate, socioeconomic status, sponsor and location predicted adjusted averages of schools, mediated the strength of relationships between mathematics achievement and mathematics efficacy, and motivational factors, and moderated the gender and achievement gaps. The implications of the results are discussed in chapter 5.

## CHAPTER FIVE

### SUMMARY, DISCUSSION, CONCLUSION AND RECOMMENDATIONS

#### 5.1 Introduction

The purpose of this study was to explore the relationships between students' motivational and socio-demographic factors, and their mathematics achievement and mathematics self-efficacy, while controlling for school factors. The four students' motivational scales were individual determination, learner preparedness, extrinsic motivation, and effort and persistence. Mathematics self-efficacy and mathematics achievement were alternately included as predictors and predicted for each other. The alternate use of mathematics achievement and mathematics self-efficacy as the predicted and predictor of each other was based on reciprocal determinism theory (Bandura, 1986) and social cognitive theory (Bandura, 1999). School location, sponsor, climate and socioeconomic status were utilized for the prediction of adjusted school averages, the strengths of relationships between motivational factors and mathematics achievement and self-efficacy, and the moderation of gender and race gaps, using two level hierarchical linear models. The following is a summary and discussion of the findings. Recommendations from the study and for further research are presented later. Conclusions and limitations of the study complete this chapter.

## 5.2 Summary and Discussion

### 5.21 Mathematics achievement, self-efficacy and motivational factors

Two multiple linear regression models, in which mathematics achievement and mathematics self-efficacy were alternately fitted as dependent variables, were employed. The results revealed that all of the variables had significant relationships with both mathematics achievement and mathematics self-efficacy, accounting for more than 34 % and 23% respectively.

Mathematics achievement is critical to both the individual and the economy, not only in the U.S. but the world over (Peterson, Woessman, Hanushek and Lastra-Anadón, 2011; Hoyles et al., 2002; Gemici & Rojewski, 2010). Mathematics' role in and relationship to science, technology and engineering makes the concern about underachievement very pertinent. Mathematics is a tool and partner in these core subjects, and indeed in most other subjects. Furthermore experts claim that mathematics underachievement portends individual, corporate and national disadvantage in global competitiveness in the science, technology, engineering, and mathematics related fields.

While some studies observed an overemphasis on the provision of facilities, technology and teacher quality (King & Newman, 2002), the current study results show that students' psychological, physiological and social factors also have significant relationships with mathematics achievement. This is consistent with other studies that concluded that the level of motivation, self- perceptions, self-efficacy, anxiety and preparedness influence mathematics outcomes, and performance in most areas (Johnson, 2008; Pajares, 2002). Physical and human resources in classrooms need to be accompanied with affective preparation for productive schooling.

The results also showed that different motivational scales had different relationships with both mathematics self-efficacy and mathematics achievement. For example, self-perceived effort and persistence, and extrinsic motivation had significant negative relationship with mathematics achievement, while learner preparedness negatively related to self-efficacy. It was expected that effort and persistence could positively relate to achievement. It could seem that genuine effort and persistence as measured by these items could be dubbed “hard work” which could be expected to bring higher achievement. However, this study revealed that effort and persistence was negatively related to mathematics achievement.

The negative relationship between effort and persistence and mathematics achievement is consistent in large data sets. For example, Shen & Talavera (2003), analyses of 8<sup>th</sup> grade mathematics and science scores in TIMSS showed that students who rated themselves lower in ability performed better than those that rated themselves highly. Shen & Talavera (2003) concluded that such outcomes were due to differences in curricula, culture and level of mathematics. Furthermore, the study associated the ratings to the expectations and general self-perception of the students, rather than realistic self-assessments. Because the database used in the current study is similar to the other large databases, and U.S., classrooms are still diverse by race, language levels, staffing, curriculum and resources, and— by extension— expectations, the negative relationship between effort and persistence and achievement, seems to be consistent.

Most students generally view mathematics as the most difficult subject. It is also one of the worst performed (Howley & Gunn 2003). Any effort on the subject, whatever the magnitude may be perceived as an attempt at an impossible task, and thus students’ self- perceived effort and persistence may not be the required level to cause change in achievement. Teachers may

reinforce this with unstandardized classroom expectations. The result is that students' perceived effort and persistence does not translate to higher scores in standard national cognitive test.

Students' responses sometimes imply expected intentions, since they can conform to either normative beliefs— where they give answers expected of them, or control beliefs— where they mean what they say but do not have control of what they learn or want to learn, or behavioral beliefs—where their answers are dependent on the expected consequences (Ajzen, 2002). However, intentions are not enough to influence outcomes. Most students have intentions and believe they can do well in mathematics, but normally they need more: guidance, structure, and consistency, to perform well in standardized cognitive tests.

Extrinsic motivation also had a negative relationship with mathematics achievement. According to Deci & Ryan (2002), extrinsic motivation occurs when one is driven to a given behavior that is unrelated and separable from the actions. Ordinarily, when one desires good grades or better future life, the more one is expected to work and, therefore the higher one's achievements are expected to be. According to Watanabe et al. (2001), the expectation of rewards makes people work hard. It is a common belief that students are motivated by good grades and the hopes that their efforts will be rewarded by jobs and financial stability. In this study, however, extrinsic motivation was negatively related to mathematics achievement. This could be for various reasons.

Firstly, mathematics is best learned intrinsically (Schunk et al. 2008) and achievers could not necessarily be motivated only by grades but also by proper understanding of the subject concepts. According to Elliot & Anseel (2009) the perception of tasks and setting of goals are driven by three approaches: mastery approach, where the individual aims at mastering the content; performance approach, where the individual aims at showing that they are better than

peers; and avoidance approach, where the individual avoids the task because their incompetence can be exposed. Performance and avoidance approaches address external expectations such as good grades, prizes, praise, honor rolls, or college entry requirements. The low-achieving learners in high school could be viewed as fitting the avoidance and performance approach, while the higher achievers could have the mastery approach. However, achievement in mathematics—especially in standardized national test— requires mastery approach.

Secondly, responses to self-perception items more often than not show good intention, but actualizing the intention could be a challenge (Ajzen, 2002). Indeed, with the diversity in American classrooms, where teachers have varied expectations, economy is highly monetized, and students gauge themselves in relation to peers, extrinsic motivation can easily be an expression of a good intention rather than an actuality. Effective extrinsic motivators should be immediate, consistent, related and commensurate to the activity performed. Unstandardized grading in classrooms, and diversity of both students and teachers, are some of the hindrances in effective use of rewards, especially in mathematics.

Lastly, overreliance on external motivators can be frustrating. Extrinsic motivation could present the negatives associated with rewards: over-justification, more controlling than informing role, and a discrepancy between belief and behavior (outcome) (Deci, 1975; Lepper et al., 1973). Intrinsic motivation ensures best the learning, because the outcomes can be attributed to the actions taken (Schunk et al., 2008).

Mathematics self-efficacy had a negative relationship with learner preparedness. One possible explanation for this negative relationship is that, students who are conscious of their deficiencies in mathematics may rate themselves lower in self-efficacy, but may also be the ones who are readier to learn and work hard. They go to classrooms prepared to learn, which



translates to achievement. Learner preparedness, by contrast had a positive relationship with mathematics achievement. This was expected because the students who prepare for class are the ones thinking about the subject out of classroom. They may be interested, and hoping to achieve. Preparation for class, especially through homework, is a positive step towards achievement. Since in most American classrooms, spare supplies like paper, pencils and school textbooks are available, coming to class without materials seldom interferes with instruction, making the scale a weak measure of achievement. However, the last item “coming to class without homework done,” would definitely point towards stronger relationship with mathematics achievement.

Individual determination positively related to both mathematics achievement and mathematics self-efficacy as expected. Individual determination is perceived in light of autonomy and competence as defined in self-determination theory. According to Deci & Ryan (2002), competence—the feeling of effectiveness in one’s continuous interaction with the social environment, experiences of opportunity, and expression of one’s capability—leads people to seek challenges that are optimal for their capacities. Students who believe in their actions, feel in charge, and feel responsible for the outcomes (autonomous), are likely to show higher performance levels than the non-autonomous (Schunk et al., 2008). These are the ones expected to show high individual determination.

Race indicators in the study were the gaps associated with the large minority groups: Black and Hispanic students. There were significant underperformances in mathematics by both groups when compared with the rest of the students. The results were consistent with other studies that showed gaps between the races and gender on academic achievement (Alano et al., 2010; Engberg & Wolniak, 2010; Peguero, 2010). Several studies have found that White

students perform significantly better than Black and other races (Flores, 2007; TUDA, 2011; Peterson et al., 2011; Strutchens & Silver, 2000). Although this analysis is not specifically a comparison with only White students, White students were the majority when grouped together with others and compared with the single Black or Hispanic groups.

Hispanic students' achievement gap has been associated with low language proficiency, immigration status (Peguro, 2010), and lower parental involvement. Alano et al. (2010) observed that Hispanic parents generally experience handicap in transmitting their educational advantages to their children compared to other parents. This was attributed to the lower understanding of the U.S. education system, hindrances to participation because of immigration statuses, low SES (especially due to low income because of unemployment and low wages), and a comparatively low level of parental education with which to assist their children. These disadvantages for Hispanic students are mirrored in their performance (Milne & Plourde, 2006).

According to NAEP, large cities in the U.S. that have persistently underachieved such as Atlanta, Baltimore City, Chicago, Cleveland, Detroit, District of Columbia (DCPS), Fresno, Los Angeles, Milwaukee and Philadelphia, have predominantly non-White populations. It can be argued, then, that Black and Hispanic underachievement is related to the inner city problems like poverty, unemployment, drug use, higher crime rates, and single parenthood. All of these have negative implications on achievement. The situation is compounded by little resources and underprepared teachers.

The male students outperformed female students in both achievement and self-efficacy. The trend of gender gap in favor of males is a common trend in most parts of the world. For example, the 2009, PISA results revealed that, in OECD countries, boys' outperformed girls in mathematics by 12 score points – a gender gap that was only one-third as large as that for

reading, in which girls outperformed boys. This was the trend in 35 out of the 65 countries that participated. Girls enter and graduate from all levels of education at higher rates than boys, but are less represented in STEM related fields. Girls have been found to perform less than boys in competitive situations, but their performance is enhanced with trials and retrials (Cotton, McIntyre, & Frank, 2013). The study also asserted that females do well in non-competitive careers, and STEM related fields are seen as competitive. An international cognitive test could seem very competitive, and therefore be associated with their lower performance than boys. Despite the explanations, this study confirms the persistence of the gender and race gaps in mathematics achievement that needs special attention.

Both Hispanic and Black students' mathematics self-efficacy was higher when compared to the others. According to Sciarra (2010), the more mathematics courses a student takes especially of higher level, the higher the achievement. Most non-White students limit the courses they take to graduation requirements, meaning they have little experience with higher mathematics, and may have difficulty with advanced mathematics. Students who experience difficulty in mathematics, at whatever level, are likely to rate their self-efficacy lower than those who have not. In other words, the low achievers could be rating themselves higher based upon what they believe rather than what they have experienced.

#### 5.22 Adjusted school averages

HLM analyses were utilized to determine which of the level-2 factors that predicted adjusted school averages for mathematics achievement and mathematics self-efficacy respectively. Mathematics self-efficacy and mathematics achievement are concurrently discussed for social-economic status, and location. Sponsor and climate were found not to be significant in

predicting adjusted school averages for both mathematics achievement and mathematics self-efficacy.

Socioeconomic status was found to be very important in determining the adjusted school averages for both mathematics achievement and mathematics self-efficacy. According to Howley & Gunn (2003), schools in the high socioeconomic status are patronized by educated parents, with higher incomes, in better regarded occupations, and living in high status locations. These components used in the measure of socioeconomic status have social, cultural and human capitals that translate into advantages for their children over and above those lower in the socioeconomic ladder (Engberg & Woniak, 2010). The parents have higher expectations of their children and demand from them higher achievement. They have aspirations for their children and help them towards the goals, by not only being available but also providing resources required such as tutoring, extra academic related assignments and trips, and role modeling.

According to Milne & Plourde (2006), healthy relationships, constant guidance, and time spent with children, have a great impact on academic achievement than the resources per se. Parents in high socioeconomic status earn higher wages in less time, compared to lower socioeconomic status parents. They may opt to work fewer hours and spend more time with their children, monitoring their activities and helping them with their school work. Others opt for one parent employed and a full-time child care parent, since their incomes can afford it. Their availability controls the children's leisure time and choice of activities and, in most cases, helps them with homework and extra reading. This is expected to translate to higher achievement.

Higher socioeconomic status parents are likely to live in cities with high property values. Most school district funding comes from revenue from property taxes (Gabriel, 2010). The residents in these locations are resourceful, educated and influential society members. Their

school districts are better endowed with physical resources, personnel and social networks. They can afford most of the learning resources required in their schools, and this enhances mathematics achievement (Engberg & Wolniak, 2010).

As expected, mathematics self-efficacy related positively with socioeconomic status. According to Linnenbrink & Pintrich (2003), self-efficacy forms the foundation of human motivation, well-being and personal accomplishment. The four sources of self-efficacy were mastery experience, vicarious experience, verbal persuasion and psychological states (Bandura, 1997). Children of informed parents, in well-resourced schools, and with the best teachers could be expected to get good experiences vicariously, verbally and therefore master the academic content. These experiences are expected to develop high self-efficacy. If the children are motivated to be like their high socioeconomic status parents, they may master their academic work and raise their efficacy.

Location was only significant in predicting mathematics achievement when comparing rural and urban schools. It was found that rural schools have a significantly higher adjusted school average than urban schools. It has been argued that urban school children, especially those in the inner city, could be living in areas prone to crime and drug use, with one parent or both unemployed, and poor housing. Besides this, urban schools have disproportionately high non-White students, especially Black and Hispanic students. Since White students generally perform better than both Black and Hispanic, urban schools performed less than rural schools, as expected.

#### 5.23 Motivational factors and the school contexts

When comparing the urban and suburban schools, location became significant mediator in the relationship between mathematic achievement and extrinsic motivation. Students in

suburban schools were predicted to show weaker relationships between mathematics achievement and extrinsic motivation. According to Schunk et al. (2008) extrinsic motivation is a goal-directed activity instigated and sustained by factors unrelated to the activity. Inner city adolescents are exposed to life of impoverishment and misery (Bolland, 2003). It can be inferred, then, that any positive effort is related to getting out of such impoverishment. School becomes a hope for future employment and financial security.

Learner preparedness was a more significant predictor of mathematics achievement in public schools than in other schools. A student who goes to a public school, but is unprepared for learning, is likely to miss out much more than in a Catholic or private school. Catholic and other private schools emphasize discipline, religion, and certain common values. Students and teachers in these schools are rarely unprepared for academic activities. The student groups are more homogenous and, therefore, more controllable. By being private, it is expected that arrangements for the provisions of school supplies could be less difficult than in a public school, where it may be complicated by bureaucracy, delays, and sometimes staff politics. Students who go to public schools are negatively impacted more by unpreparedness than those in private or other schools.

Socioeconomic status was a significant mediator between mathematics achievement and individual determination in the rural and urban locations. According to Howley & Gunn (2003) and Flores (2007), rural and urban schools have disproportionately larger numbers of poor students, are less likely to have qualified mathematics teacher, and are more likely to lack enough computers and other school supplies. The studies concluded that, this represents an “opportunity gap” which translates into achievement gap. The rural and urban areas are generally lower in the socioeconomic status ladder. With these circumstances, student achievement depends more on individual determination than it does in the suburban areas.

Mathematics achievement, as a predictor of mathematics self-efficacy, was strengthened by socioeconomic status. Parents with high socioeconomic status are more informed and resourceful to their children. Their children, who have more contact with academic work especially out of school, and are more likely to be taking higher mathematics courses than counterparts in lower socioeconomic status, accurately rate their mathematics self-efficacy. Their accurate self-assessment means stronger relationships between the self-efficacy and mathematics achievement.

#### 5.24 Race and gender gaps and school contexts

The gap in mathematics achievement for Hispanic students was found to be wider in public schools than in Catholic and other schools. Other studies have indicated that Hispanic students are left behind because of the struggle with English language, little parental involvement and immigration status (Peguero, 2010; Alano et al., 2010). The efforts made by public schools to address these problems are not sufficient. Programs that specifically address teaching mathematics in Spanish and other languages, for the purpose of conveying the concepts to students struggling with English are rare. Apart from the ESL classes offered in these institutions, most courses, including mathematics are still taught in English. Although other communities with language problems counter this argument, as mentioned early, Hispanic parents have unique circumstance: they are more likely to be illegal immigrants, which hinders employment and parental involvement in school activities, generally hold a lower education level, and are more likely to be monolingual Spanish speakers.

The significant role school climate plays on the Black students' mathematics achievement gap is an indicator that Black students are more sensitive to school climate than any other groups. Since Black students are disproportionately represented in large cities, which are

persistently performing below average both nationally and at the state level, it is a pointer that predominantly Black student schools need special attention in relation to school climate.

The gender gap in mathematics self-efficacy in public schools was higher than in other schools and it was also higher in rural and suburban schools. The strong negatively impacting circumstances of inner-city life (Bolland, 2003) may be affirming trends towards female independence, and the diffusion of traditional gender roles faster in urban areas than in other areas.

### 5.3 Conclusions

One of the major motivational variables in the study is mathematics self-efficacy. Mathematics self-efficacy was defined as an individuals' self-perception of his/her ability to correctly solve mathematics problems. According to Bandura (1986), self-beliefs have significant relationships with outcomes, because they are accepted as self-prophecy. Therefore strong beliefs and perspectives about ability have a significant impact on achievement. Variables that relate significantly with mathematics self-efficacy directly or indirectly relate to mathematics achievement. This study established that strong and significant relationships exist between mathematics achievement and mathematics self-efficacy. The study also established the strength of their roles as predictors of each other. This agrees with Bandura's reciprocal determinism theory.

According to the triadic reciprocal determinism model, and the sources of self-efficacy theory (Pajares, 2002; Bandura 1997), mastery experience, vicarious experience, verbal persuasions, and somatic emotional states influence and are influenced by self-efficacy. The relationships imply that, not only should the factors that predict self-efficacy be examined, but researchers should also find out how self-efficacy predicts the same factors. The bi-directional



interaction was established in this study, and found to have significant relationship with mathematics achievement.

Gender and race gaps in mathematics achievement still persist. These two common demographic characteristics have not been examined in terms of grouping students into some special groups that require unique interventions. Until something is done that uniquely addresses each group, their inclusion in the studies will be for other reasons other than intervention. There is need for proper examination on why gender and race gaps continue to persist in mathematics and related fields.

Socioeconomic status was the most significant level -2 variable for both mathematics self-efficacy and mathematics achievement. Despite its common use, several other studies showed that it is not due to a lack of the resources even in the lower cadres, but rather due to how much prioritizing, relationship-building, and education valuing occurs in each socioeconomic level. The motivational factors in this study were critical in addressing mathematics achievement. The relationship between level-2 and level-1 variables not only confirms the hierarchical relationship, but fits into the conceptual framework of this study. Mathematics achievement and self-efficacy outputs are as a result of bi-directional, triadic interactions with varied magnitudes.

#### 5.4 Recommendations from the study

1. Although mathematics self-efficacy and mathematics achievement are positively related, the strength of the relationships dependent on school context and student factors. It is important for teachers to understand their students and find the best way to use the relationship to improve mathematics achievement. As with many other educational

psychology theories, training in self-efficacy and motivation theories is recommended during teacher training and professional development.

2. Psychological factors have significant relationships with achievement. More often than not, more school resources are expended on the improvement of school staff welfare and the provision of physical facilities, curriculum and technology for learning than on student's psychological well-being. The researcher recommends that more attention be paid to other services that influence the students' psychological states, such as: reevaluating the students' understanding of the meaning of school, connecting classroom content with real life (as often happens in upper socioeconomic status groups), and assisting students to set higher expectations by exposing them to common experiences.
3. Student groups are made diverse by many factors. Efforts should be made in finding out which techniques help which group in improving achievement. While learning a common language like English should be the aim, it should not be a prerequisite in teaching other subjects such as mathematics. To boost motivation and encourage understanding of mathematics concepts, mathematics should be taught with an aim of assisting students master mathematical concepts. This should not necessarily be preceded by proficiency in Standard English. This may address the problem of the Black and Hispanic students' underachievement in mathematics.
4. Although trends in higher education show female students have higher rates in high school graduation, college enrolment and graduation and completion time, the trends are in certain courses (The Economist, 2011). Science, technology, engineering and mathematics are still significantly topped by males. Gender-sensitive instruction has not been effected well. Since psychological states, self-efficacy and motivation relate

differently to achievement, teachers need to be cautious during instruction to avoid conflicting responses, or seek alternatives that have common outcomes.

5. Socioeconomic status significantly predicted achievement and mathematics self-efficacy.

It is clear that differences continue to hurt those lower on the scale. Elected leaders and Boards of Education need to be assertive about measures that reduce gaps in socioeconomic status. Institutions of learning, especially k-12 schools, should not be reflections of social inequity.

### 5.5 Recommendations for further research

1. The reasons for the gender, race, location and sponsor gaps in mathematics self-efficacy and mathematics achievement, and indeed all the other motivational scales used in this study, require further investigation. When better understood, their use in intervention in mathematics achievement will be of greater value.
2. The role of school climate was insignificant in all analyses except for the mathematics achievement of Black students in the context of rural and suburban locations. There is need for further research to determine its constitution as a scale, and or its role in academic achievement.
3. The motivational scales discussed in this paper were constructs named by the researcher. A study of the items that clustered during principal factor analysis could identify other items that could be added or clustered afresh. Other psychological factors that relate to mathematics achievement and self-efficacy could be explored in light of other motivation theories. Further research is recommended in the factor analysis for specific groups and locations.

4. This study used data from high school students. The researcher wondered what the results would be for elementary and middle school students. Indeed, since mathematics starts to concretize at middle school, this study could be very valuable if replicated using data from those levels.

#### 5.6 Limitations

1. The data used for analysis was collected from 10<sup>th</sup> and 12<sup>th</sup> grade. Understanding that mathematics starts from as early as pre-school, the conclusions may not be generalizable.
2. The motivational predictor variables were based on the 10<sup>th</sup> grade data, but used in predicting mathematics self-efficacy and achievement at 12<sup>th</sup> grade. This researcher kept wondering if the outcomes would be any different if those predictor variables were closer in time. Indeed, two years' difference for the motivational scales could shift an individual's scales significantly.
3. America is extremely diverse, yet this sample was national. Although it is representative of the nation, more homogenous groups could have different outcomes. Units of analysis such as particular schools, school districts, or even states, could identify unique relationships useful for the organizations designing intervention strategies.

## REFERENCES

- Ajzen, I. (2002). Perceived behavioral control, self-efficacy, locus of control, and the theory of planned behavior. *Journal of Applied Social Psychology* 32: 665–683.
- Akey, T. M. (2006): School context, student attitudes and behavior, and Academic Achievement: An exploratory analysis. Retrieved 09/22/2012 from <http://www.mdrc.org/publications/419/full.pdf>
- Alon, S., Domina, T., Tienda, M. (2010). Stymied mobility or temporary lull? The puzzle of lagging Hispanic college degree attainment. *Social Forces*.88(4): 1807-1832.
- American Psychological Association, Task Force on Socioeconomic Status.(2007).Report of the APA Task Force on Socioeconomic Status. Washington, DC: American Psychological Association. Retrieved 13/03/2013 from <http://www.apa.org/pi/ses/resources/publications/task-force-2006.pdf>
- Baer, J. (1998). Gender Differences in the Effects of Extrinsic Motivation on Creativity. *Journal of Creative Behavior*, 32, 18-37.
- Bagaka's, J. G. (2011). The role of teachers' characteristics and practices on upper secondary school students' mathematical self-efficacy in Nyanza province of Kenya: A multilevel analysis. *International Journal of Science and Mathematics Education*, 9(4), 817-842
- Bandura, A. (1989). Human agency in social cognitive theory. *American Psychologist* 44, 1175-1184.
- Bandura, A. (1999). Social cognitive theory of personality in L. A. Pervin& O. P. John (Eds.), *Handbook of personality: Theory and research* (2nd ed., pp. 154-196). New

- York: The Guilford Press. Retrieved on 12/22/2011 from  
<http://books.google.com/books?id=b0yalwi1HDMC>
- Bogard, K. (2005). Affluent adolescents, depression, and drug use: The role of adults in their lives. *Adolescence*, 40, 281-306.
- Bolland, J. M. (2003). Hopelessness and risk behavior among adolescents living in high-poverty inner-city neighborhoods. *Journal of Adolescence*, 26, 145–158.
- Brunner, M. (2008). No g in education? *Learning and Individual Differences*, 18(2), 152- 165.
- Carbonaro, W., Covay, E. (2010). School Sector And Student Achievement In The Era Of Standards Based Reforms. *Sociology of Education*, 83(2): 160-182.
- Casanova, F. P., Garcia-Linares, M.C., Torre, M.J., & Carpio, M.V., (2005). Influence of family and socio-demographic variables on students with low academic achievement. *Educational Psychology*. 25(4). 423-435.
- Cassady, J. C. & Johnson, R. E. (2002). Cognitive test anxiety and academic performance. *Contemporary Education Psychology* 27, 270-295
- Coleman, J.S. (1993). The rational reconstruction of society *American Sociological Review*, 58, 1–15.
- Cotton, C., McIntyre, F. & Price, J. (2013). Gender differences in repeated competition: Evidence from school math contests. *Journal of Economic Behavior & Organization*, 86, 52-66. Retrieved 04/12/2013 from  
<http://www.sciencedirect.com/science/article/pii/S0167268112003010>
- Darling-Hammond, L. (2010). The flat world and education: How America's commitment to equity will determine our future. NY: Teachers Colleges Press

- Darling, N. & Steinberg, L. (1993). Parenting style as context: an integrative model. *Psychological Bulletin*, 113, 487–496.
- Darwing (2012): What is Mathematics? Retrieved 06/12/2012 from <http://darkwing.uoregon.edu/~moursund/Math/mathematics.htm>
- Deci, E. L., & Ryan, R. M. (2000). The "what" and "why" of goal pursuits: Human needs and the self-determination of behavior. *Psychological Inquiry*, 11, 227-268.
- Deci, E., & Ryan, R. (Eds.), (2002). *Handbook of self-determination research*. Rochester, NY: University of Rochester Press.
- Dicknison, L. (1995). Autonomy and motivation; A literature review. *Pergamon* 23(2), 165-174
- Domina, T. (2005). Leveling the home advantage: Assessing the effectiveness of parental involvement in elementary school. *Sociology of Education*, 78, 233-249
- Engberg, M. and Wolniak, G. (2010). Examining the Effects of High School Contexts on Postsecondary Enrollment. *Research in Higher Education*, 51(2): 132-153.
- England, D W. (2006). Relating individual and collective teacher and efficacy beliefs with urban fourth-grade students' reading and mathematics performance (Unpublished doctoral dissertation), Cleveland State University Cleveland, Ohio
- Fan, W. and Williams, C. M. (2010). The Effects of Parental Involvement on Students' Academic Self-Efficacy, Engagement and Intrinsic Motivation. *Educational psychology*, 30(1): 53-74.
- Fleischman, H. L., Hopstock, P. J., Pelczar, M. P. & Shelley, B. E. (2010). Performance of U.S. 15-year-old students in reading, mathematics, and science literacy in an international context. Retrieved 08/17/2012 from <http://nces.ed.gov/pubs2011/2011004.pdf>

- Flores, A. (2007). Examining disparities in mathematics education: Achievement gap or opportunity gap? *The High School Journal* October /November 29-42
- Gabriel, T. (2010). Proficiency of black students is found to be far lower than expected. *The New York Times* Retrieved 03/23/2013 from [http://www.nytimes.com/2010/11/09/education/09gap.html?\\_r=0](http://www.nytimes.com/2010/11/09/education/09gap.html?_r=0)
- Gemici, S. and Rojewski, J.W. (2010). Contributions of Cooperative Education in Preparing At-Risk Students for Post-High School Transition. *Journal of Education for Students Placed at Risk*, 15(3): 241-258.
- Goddard, R. D., Hoy, W.K., Hoy, A. W. (2002). Collective efficacy beliefs: Theoretical developments, empirical evidence, and future directions *Educational Researcher* 33(3) 3-13
- Goodwin, K. S., Ostrom, L., Scott, K. W. (2009). Gender differences in mathematics self-efficacy and back substitution in multiple-choice assessments. *Journal of Adult Education*, 38, 22-42
- Greenwald, A. G., Pratkanis, A. R., Leippe, M. R., & Baumgardner, M. H. (1986). Under what conditions does theory obstruct research progress? *Psychological Review*, 93, 216–229.
- Gutman, L. M. (2006). How student and parent goal orientations and classroom goal structures influence the math achievement of African Americans during the high school transition. *Contemporary Educational Psychology*, 31, 44–63.
- Halpern, D.F., Benbow, C.O., Geary, D.C., Gur, R.C., Shibley-Hyde, J., & Gernbacher, M.A. (2007). The science of sex differences in science and mathematics. *Association for Psychological Science* 8(1), 1–51.



Hanushek, E. A., Peterson, P. E., & Woessmann, L. (2010): U. S. math performance in global perspective: How well does each state do at producing high-achieving students?

Retrieved 11/16/2012 from [http://www.hks.harvard.edu/pepg/PDF/Papers/PEPG10-19\\_HanushekPetersonWoessmann.pdf](http://www.hks.harvard.edu/pepg/PDF/Papers/PEPG10-19_HanushekPetersonWoessmann.pdf)

Hannula, M. S. (2006). Motivation in mathematics: Goals reflected in emotions. *Educational Studies in Mathematics*, 63(2), 165-178.

Harkness, S. S., D'Ambrasio, B., & Morrone, A. S. (2007). Pre-service elementary teachers' voices describe how their teacher motivated them to do mathematics. *Educational Studies in Mathematics*, 65(2), 235-254

Herzig, A. H. (2004). Becoming mathematicians: Women and students of color choosing and leaving doctoral mathematics. *Review of Educational Research*, 74, 171-214.

Hemmings, B., Grootenboer, P., Kay, R. (2011). Predicting mathematics achievement: The influence of prior achievement and attitudes. *International Journal of Science and Mathematics Education* 9 (3), 691-705.

Howley, C., & Gunn, E. (2003). Mathematics achievement in the rural circumstance *Journal of Research in Rural Education*, 18(2), 86-95.

Hoyles, C., Wolf, A., Molyneux-Hodgson, S. & Kent, P. (2002). Mathematical skills in the workplace final report to the science, technology and mathematics council. retrieved on 09/07/2012. <http://eprints.ioe.ac.uk/1565/1/Hoyles2002MathematicalSkills.pdf>

Irvin, M. J., Meece, J. L., Byun, S., Farmer, T. W., & Hutchins, B. C. (2011). Relationship of school context to rural Youth's educational achievement and aspirations *Journal of Youth and Adolescence*, 40(9), 1225-1242

- Jacobs, J. E., Lanza, S., Osgood, D. W., Eccles, J. S., & Wigfield, A. (2002). Changes in children's self-competence and values: Gender and domain differences across grades one through twelve. *Child Development*, 73, 509 – 527.
- Jagacinski, C. M., Kumar, S., Boe, J. L., Lam, H., & Miller, S. A. (2010). Changes in achievement goals and competence perceptions across the college semester *Motivation and Emotion*, 34(2), 191-204
- Johnson, C. W. (2008): The link between teacher practices and high school students mathematics self-efficacy: A multi-level analysis (unpublished doctoral dissertation) Cleveland State University, Cleveland OH
- Johnson, J. (2010) New York times “International Education Rankings Suggest reform Can Lift U.S.” Retrieved 05/14/2012 <http://www.ed.gov/blog/2010/12/international-education-rankings-suggest-reform-can-lift-u-s/>
- King, B., & Newman, F.M. (2000). Will Teacher Learning Advance School Goals?” *Phi Delta Kappan* 81(8), 576
- Kominski, R., Jamieson, A. & Martinez, G. (2001). At risk conditions of US school age children *U.S Census Bureau, Population Division, Education & Social Stratification Branch Retrieved on 11/12/2011*  
<http://www.census.gov/population/www/documentation/twps0052/twps0052.html>
- Lepper, M. R., & Hodell, M. (1989). Intrinsic motivation in the classroom In C. Ames & R. Ames (Eds.), *Research on motivation in education* (Vol. 3, p.73-105) San Diego: Academic Press
- Linnenbrink, E. A., & Pintrich, P. R. (2003). The role of self-efficacy beliefs in student engagement and learning in the classroom. *Reading and Writing Quarterly*, 19, 119-137.

- Marjoribanks, K. (2003). Learning environments, family contexts, educational aspirations and attainment: A moderation-mediation model extended. *Learning Environments Research*, 6(3), 247-265.
- Marjoribanks, K. (1999). Environmental and individual influences on adolescents' aspirations: A moderation-mediation model *Learning Environments Research*, 2(1), 43-63.
- Maslow, A. H. (1943). A Theory of Human Motivation *Psychological Review*, 50, 37
- Matsui, T., Matsui, K., & Ohnishi, R. (1990). Mechanisms underlying math self-efficacy learning of college students. *Journal of Vocational Behavior*, 37, 225-238
- Mayer, R. E. (2000). Intelligence and education. In R. J. Sternberg (Ed.), *Handbook of intelligence* (pp. 519–533). Cambridge, UK: Cambridge University Press.
- Meece, J. L., Wigfield, A., & Eccles, J. S. (1990). Predictors of math anxiety and its consequences for young adolescents' course enrollment intentions and performances in mathematics. *Journal of Educational Psychology*, 82, 60-70.
- Meece, J. L., Glienke, B. B. & Burg, S. (2006). Gender and motivation. *Journal of School Psychology* 44(2006), 351-373
- Mickelson, R. A. (1990). The attitude achievement paradox among black adolescents *Sociology of Education* 63 (January), 44-6

Mji, A. & Makgato, M. (2006): Factors associated with high school learners' poor performance: a spotlight on mathematics and physical science *South African Journal of Education* 26 (2).

Nauta, M. M., Epperson, D. L., & Kahn, J. H. (1998). A multiple-groups analysis of predictors of higher level Career Aspirations among women in mathematics, science, and engineering majors. *Journal of Counseling Psychology*, 45(4), 483- 496.

NAEP (2011): The Nation's report card: Mathematics 2011. Retrieved 06/27/2012 from <http://nces.ed.gov/nationsreportcard/pubs/main2011/2012458.aspx>

NCES 2008-319 (2008): Mathematics course taking and achievement at the end of high school: Evidence from Educational Longitudinal Study 2002 (ELS: 2002). Statistical Analysis Report NCES 2008-319 Retrieved 11/26/2011 from <http://eric.ed.gov/PDFS/ED499546.pdf>. retrieved 11/26/2011

NCES(2010): Low-performing students: Percentage of U.S. students at the lowest proficiency levels relative to international peers on the most recent international assessments in reading, mathematics, and science: Results from PIRLS 2006, TIMSS 2007, and PISA 2009. Retrieved on 08/12/2012 <http://nces.ed.gov/surveys/international/reports/pdf/2012-lps-mrs.pdf>.

Newton, X. A., Torres, D., Rivero, R. (2008). Making the connection: Timing of taking algebra in secondary schools and future college STEM participation. Retrieved 07/01/2012 from [http://www3.airweb.org/images/final\\_research\\_paper\\_newton\\_2008.pdf](http://www3.airweb.org/images/final_research_paper_newton_2008.pdf)

Nicolaidou & Philippou, 2012. Attitudes towards mathematics self-efficacy and achievement in problem solving. *European Research in Mathematics Education* 2, 1-11

- Ogbuehi, P. I. and Fraser, B. J. (2007). Learning environment, attitudes and conceptual development associated with innovative strategies in middle-school mathematics. *Learning Environments Research* 10 (2), 101 – 114.
- Pajares, F. (1996). Self-efficacy beliefs in academic settings *Review of Educational Research* 66, 543-578
- Pajares, F. (2002). Overview of the social cognitive theory and self-efficacy, Retrieved 11/22/2012 from <http://www.uky.edu/~eushe2/Pajares/eff.html>
- Peguro, A. A. (2010). A profile of Latino school-based extracurricular activity involvement *Journal of Latinos & Education*, 9(1): 60-71.
- Peterson, P.L. & Fennema, E. (1985). Effective teaching, student engagement in classroom activities and sex related differences in learning mathematics. *American Educational Research Journal* 22(3), 309-335 Retrieved 11/21/2012 from <http://aer.sagepub.com/content/22/3/309.full.pdf>
- Peterson, P. E., Woessman, L., Hanushek, E. A., Lastra-Anadón, C. X. (2011). Globally Challenged: Are U.S. students ready to compete? Retrieved on 06/12/2012 from [http://www.hks.harvard.edu/pepg/PDF/Papers/PEPG11-03\\_GloballyChallenged.pdf](http://www.hks.harvard.edu/pepg/PDF/Papers/PEPG11-03_GloballyChallenged.pdf)
- Phelps, C. M. (2010). Factors that pre-service elementary teachers perceive as affecting their motivational profiles in mathematics. *Educational Studies in Mathematics*, 75(3), 293-309

- Phillips, S.D., Burns, B. J., Wagner, H. R., Kramer, T. & Robbins, J. M. (2002). Parental incarceration among adolescents receiving mental health services. *Journal of Child and Family Services* 11(4) 385-399
- Raudenbush, S. W. & Bryk, A. S. (2002). Hierarchical linear models: Applications and data analysis methods 2<sup>nd</sup> edition. Thousand Oaks, London. Sage
- Reeve, J. (2010). Self-determination theory applied to Educational settings.
- Ryan, R. M.; Connell, J. P. (1989): Perceived locus of causality and internalization: Examining reasons for acting in two domains. *Journal of Personality and Social Psychology*, 749-769 57(5)
- Sasson, R. (2010). What is motivation and how to strengthen it. Retrieved on 7/20/2010 from [http://www.successconsciousness.com/strengthen\\_motivation.htm](http://www.successconsciousness.com/strengthen_motivation.htm)
- Schunk, D. H., Pintrich, P. R. & Meece, J. L. (2008): *Motivation in education: Theory research and application*. New Jersey, Pearson.
- Sciarra, D. T. (2010). Predictive Factors in Intensive Math Course-Taking in High school. *Professional School Counseling*, 13(3): 196-207.
- Schunk, D. H. (1989). Self-efficacy and achievement behaviors. *Educational Psychology Review*, 1, 173-208.
- Schweinle, A. & Mims, G.A (2009). Mathematics self-efficacy: Stereotype threat versus resilience, *Social Psychology of Education* 12 (4) 501-514
- Shapka, J. D., Domene, J. F. & Keating, D. P. (2006). Trajectories of career aspirations through adolescence and young adulthood: Early math achievement as a critical filter *Educational Research and Evaluation* 12(3) 347-358

- Shen, C. & Talavera, O. (2003). *The effects of self-perception on students' mathematics and science achievement in 38 countries based on TIMSS 1999 data*: (unpublished) Boston College Retrieved 04/12/2012 from <http://fmwww.bc.edu/repec/nasug2003/shen.pdf>
- Sinha, J. W., Cnaan, R. A. & Gelles, R. J. (2007). Adolescent risk behaviors and religion: Findings from a national survey. *Journal of Adolescence* 30(2), 231-249
- Smith, Mark K. (2002, 2008) 'Howard Gardner and multiple intelligences', *the encyclopedia of informal education*, Retrieved 11/25/2011 from <http://www.infed.org/thinkers/gardner.htm>.
- Steel, D. (2012): This is how you make children love math  
[http://www.washingtonpost.com/national/on-innovations/this-is-how-you-make-kids-love-math/2012/06/04/gJQAw38XDV\\_story.html](http://www.washingtonpost.com/national/on-innovations/this-is-how-you-make-kids-love-math/2012/06/04/gJQAw38XDV_story.html) Retrieved 11/22/2012
- Strutchens, M. E., & Silver, E. A. (2000). NAEP findings regarding race/ethnicity: Students performance, school experiences, and attitudes and beliefs. In E. A. Silver & P. A. Kenney (Eds.), *Results from the seventh mathematics assessment of the National Assessment of Educational Progress* (pp. 45-72). Reston, VA: National Council of Teachers of Mathematics
- TIMSS (2007): Mathematics Achievement of Fourth- and Eighth-Graders between 1995 and 2007. Retrieved on 08/12/2012 from [http://nces.ed.gov/timss/results07\\_math95.asp](http://nces.ed.gov/timss/results07_math95.asp)
- The Economist ( September 4<sup>th</sup>, 2011) retrieved 04/21/2013 from <http://www.economist.com/blogs/dailychart/2011/09/us-household-income>
- The Washington Post (December 5<sup>th</sup> 2007) retrieved 07/18/2011 from <http://www.washingtonpost.com/wp-dyn/content/article/2007/12/04/AR2007120400730.html>,

- TUDA-,2011: Trial Urban District Assessment Retrieved 11/22/2012 from  
<http://www.sandi.net/cms/lib/CA01001235/Centricity/Domain/121/assessment/pdfs/TUDA.Factsheet2011.pdf>
- Tuminaro, J. (2004). A Cognitive framework for analyzing and describing introductory students' use and understanding of mathematics in physics. *Unpublished Doctoral, University of Maryland, College Park.*
- Wang, S. & Han, S. (2001). Six C's of Motivation. In M. Orey (Ed.), *Emerging perspectives on learning, teaching, and technology*. Retrieved 10/26/2011 from  
<http://projects.coe.uga.edu/epltt/>
- Watanabe, M., Cromwell, H. C., Tremblay, L., Hollerman J. R., Hikosaka, K. & Schultz W. (2001): Behavioral reactions reflecting differential reward expectations in monkeys. *Exbrain Research* 40(4), 511-518
- Watt, H. M. G. (2004) Development of adolescents' self-perceptions, values and task perceptions according to gender and domain in 7<sup>th</sup> through 11<sup>th</sup> grade in Australian students *Child Development*, 75(5), 1556 – 1574
- Weiss, C. C., Carolan, B. V. and Smith, J. B. (2010). Big School, Small School: (Re) testing assumptions about high school size, school engagement and mathematics achievement. *Journal of Youth and Adolescence*, 39(2): 163-176.
- White-Johnson, A. F. (2001). “Peas ‘N Rice” or “Rice ‘N Peas”— Which one are we really ordering? The plight of African American male students engaged in educational exchange processes. *Urban Education* 36 (3), 343-373.



- Williams, T., Jocelyn, L., Roey, S., Kastberg, D. & Brenwald, S. (2009). Highlights from TIMSS 2007: Mathematics and science achievement of U.S. fourth and eighth-grade students in an international context Retrieved 08/12/2012  
<http://nces.ed.gov/pubs2009/2009001.pdf>
- Yau, H. K. & Kan M. S. (2011). Gender differences on Intrinsic Motivation in Hong Kong Higher Education; *e-Journal of Organizational Learning and Leadership* 9(2) 63-80  
retrieved 03/23/2013 from <http://journalofafricanamericanmales.com/wp-content/uploads/downloads/2011/08/Noble-20112.pdf>
- Yoon, J. (2002). Teacher characteristics as predictors of teacher-student relationships: Stress, negative affect, and self-efficacy *Social Behavior and Personality*, 30(5), 485-494.
- Zeldin, A. L. & Pajares, F. (2000). Against all odds: Self-efficacy beliefs of women in mathematical, scientific and technological careers; *American Educational Research Association* 37(1). 215-246
- Zimmerman, B. J.; Bandura, A & Martinez-Pons, M. (1992). Self-motivation for academic attainment: the role of self-efficacy beliefs and personal goal-setting. *American Educational Research Journal*, 29, 663-676.

## Appendix A

Scale	Questions
Mathematics self-efficacy (EFF)	<ol style="list-style-type: none"> <li>1. Can do excellent job on math tests</li> <li>2. Can understand difficult math texts</li> <li>3. Can understand difficult math class</li> <li>4. Can do excellent job on math assignments</li> <li>5. Can master math class skills</li> </ol>
Control expectation scale- Individual-Determination (IND)	<p>How often do these things happen to you?</p> <ol style="list-style-type: none"> <li>1. Can learn something really hard</li> <li>2. Can get no bad grades if decides to</li> <li>3. Can get no problems wrong if decides to</li> <li>4. Can learn something well if want to</li> </ol>
Academic climate scale (CLMT)	<ol style="list-style-type: none"> <li>1. Student morale is high</li> <li>2. Teachers press students to achieve</li> <li>3. Teacher morale is high</li> <li>4. Learning is high priority for students</li> <li>5. Students expected to do homework</li> </ol>
Action control: general effort and persistence scale (EPPER)	<p>How often do these things happen to you?</p> <ol style="list-style-type: none"> <li>1. Remembers most important things when studies</li> <li>2. Works as hard as possible when studies</li> <li>3. Keeps studying even if material is difficult</li> <li>4. Does best to learn what studies</li> <li>5. Puts forth best effort when studying</li> </ol>
Learner preparation scale (PREP)	<ol style="list-style-type: none"> <li>1. How often goes to class without pencil / paper</li> <li>2. How often goes to class without books</li> <li>3. How often goes to class without homework done</li> </ol>
Extrinsic motivation (utility interest) scale (XMTV)	<ol style="list-style-type: none"> <li>1. Studies to get a good grade</li> <li>2. Studies to increase job opportunity</li> <li>3. Studies to ensure financial security</li> </ol>